Popular science monthly

JANUARY
Reg.U.S.Pat.Off.
15 Cents

Popular Science

Founded MONTHLY

300 Pictures

Teaching an Aviator

JANUARY Reg US Pat Off 15 Cents

Popular Science

Founded MONTHLY

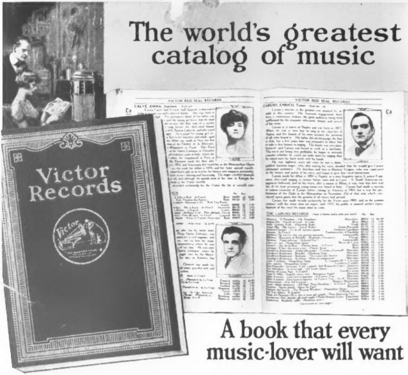
300 Pictures

Lectr. Mag.

v. 9
Jan-Ju
1918

Teaching an Aviator

The world's greatest catalog of music



A book that every music-lover will want

It has required 20 years of constant research, of steady application, of tireless effort, and the expenditure of more than Eleven Million Dollars to place this Victor Record catalog in your hands.

This great book of 542 pages is the recognized authoritative index to the world's best music; to the greatest musical achievements of all time.

Its pages are living tributes to the years of unceasing vigil spent in gathering the best music from every portion of the globe. They reflect the hours upon hours which the greatest artists have devoted to recording their superb art for the delight of all generations. They attest to the enormous amount of time and millions of dollars spent in developing the art of recording to its present state of perfection. And through each and every page runs the story and proof of Victor supremacy.

Every music-lover will want a copy of this great Victor catalog of music. Everybody should have this book, whether or not they have a Victrola. All will appreciate it because of the information about artists, opera and composers, and the numerous portraits and illustrations it contains.

Any Victor dealer will gladly give you a copy of this great catalog of music, or we will mail you a copy free, postage paid.

"HIS MASTER'S VOICE"

Victor Talking Machine Co., Camden, N. J., U. S. A.

Berliner Gramophone Co., Montreal, Canadian Distributors

Important Notice. Victor Records and Victor Machines are scientifically co-ordinated and synchronized by our special processes of manufacture, and their use, one with the other, is absolutely essential to a perfect Victor reproduction.

New Victor Records demonstrated at all dealers on the 1st of each month

Digitized by Google

For the Boys Over There

The War and Navy Departments have asked the American Library Association to provide reading matter for the soldiers and sailors. The POPULAR SCIENCE MONTHLY is one of the two most popular magazines at Camp Upton; the other is a fiction magazine. When the soldiers in camp send in their requests for magazines, they ask not only for fiction, as may be supposed, but also for the POPULAR SCIENCE MONTHLY.

This state of facts leads us to ask readers to place their copies of the POPULAR SCIENCE MONTHLY, after they have been read, at the disposal of our soldiers and also to send along other reading matter of a practical character.

The aviation camps want books on gas engines, on airplanes, on physics and on other pertinent mechanical subjects generally. The Signal Corps want books on telegraphy and electricity. All the separate trades in the Army and Navy want volumes and periodicals that will help the men to do their work better—books about our Allies, the places where our soldiers will be sent, why we are in the war, how the war is fought. Thousands of books will be required and not nearly enough have been given to meet the demand.

Send up-to-date books—books of real present value, not antiquated volumes. Many of the men are studying French and want grammars, readers and dictionaries.

Send the books to the nearest public library. There, they will be sorted and shipped to the soldiers and sailors. The American Library Association will see to it that the books are placed at the disposal of the men. In the larger camps, trained librarians are in actual charge of the library system.

The POPULAR SCIENCE MONTHLY and similar practical magazines may be sent through the Post Office by placing a one-cent stamp on the cover. Or they may be left at the library with the books. Periodicals should not be over two months old.

In case of doubt, take everything to the library. The undesirable material can be sold and the proceeds used to buy suitable books.

Money contributions may be sent to the local libraries or directly to Mr. Herbert Putnam, the General Director of the American Library Association, Library War Service, Library of Congress, Washington, D. C.

The Human Torch Makes His Spectacular Dive

Like a flaming comet, the diver, Jake Cox, plunges fifty feet from a tower into a pool of gasoline. The instant his blazing body touches the surface of the lake, the inflammable liquid is ignited, so that he seems to have plunged into a roaring volcano. He has actually done so—for the fraction of a second—but before the spell-bound spectators can collect their thoughts, he has already reappeared on the surface, forty feet away from the burning liquid

Popular Science Monthly

225 West Thirty-ninth Street, New York City

Vol. 92
No. 1

January, 1918

$1.50
Annually

The Human Torch

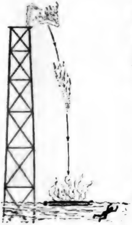
Enveloped in flames, a bold man dives from a fifty-foot tower into a lake of gasoline, transforming it into a seething furnace

IT is night time. On the top of a tower, fifty feet high, stands a queer looking figure, dressed in three suits. The outside one is of cloth, the one under it, is of rubber, and the one next to the skin is of asbestos. On his head are three rubber caps, over which is an asbestos cap that comes down to his shoulders and leaves two holes through which he can see. His gloves, his wristlets, his shoes—all are of asbestos. Directly below him is a square area of water, fenced in with logs or boards. The surface of this boxed-off section is covered with gasoline.

Suddenly an assistant steps up to the figure and lifts a bottle, from which he pours gasoline over the man's body. Around the lake stand two thousand people, fascinated by the actions of the two. In a moment, the assistant steps back from the oil-covered figure and shouts a signal to somebody below. Immediately all lights are extinguished, leaving the figure in darkness. Then the stillness is broken by the report of a revolver shot. The assistant has fired at the diver, the sparks from the revolver transforming him into a livid cone of flame. With a shout, he leaps from the platform and in a beautiful parabolic dive, plunges into the lake below. As he flies through the air, his body takes on the appearance of a torch, long tongues of flame trailing out behind him. Striking the film of gasoline, he is enveloped in a veritable inferno of fire, which erupts as soon as his fingertips touch it.

But his work is only half done. If he comes up in the lake of fire he will be burned alive. How does he escape? He swims under water some thirty or forty feet until he has passed the burning gasoline, when he rises to the surface, safely out of danger's reach. This is no easy thing to do, for his shoes and the three heavy suits greatly hinder his movements. Furthermore, he dare not open his mouth or breathe through his nose while he is taking his spectacular dive, lest the flames suffocate him.

It requires reckless courage to be a "thriller de luxe." If the slightest accident or miscalculation occurred, the "Human Torch" would be extinguished for the last time.



How the diver escaped without being burned to death is shown above. At right, above, is Jake Cox, the daredevil, dressed for the feat

How to fold the device over the edge of the glass so that even an ordinary tumbler becomes your special drinking glass

If You Value Your Life, Be Careful with Electricity

SOME safety hints for the wise, which are intended to guard against serious accidents and a possible loss of life, are being sent out broadcast by the electric light companies. From them may be selected the following: Do not cover an electric globe with paper or cloth. It may start a fire. Do not hang an ordinary lamp cord over a nail or metal work. Do not leave a cord connected when you are through with it. Do not touch any wire that is down on the ground, whether it is an electric, telephone or guy wire. In an emergency, remove a wire with an instrument equipped with a wooden handle, keeping the full length of the handle between yourself and the wire.

Make Every Glass a Sanitary Drinking Cup

THE simplest of all the recent devices for guarding against the germs, which often lurk even in drinking water, is a small piece of waxed paper, or a semicircular celluloid strip, which folds over the rim of the glass and prevents the lips from touching the surface of the tumbler while drinking.

It will fit over any glass or cup, and will ... ible for you ... ice-cream ... drink of ...re. The ...ater which ... the glass ... any sedi- ... may be in ... the glass, ... your lips. ...vention, is ... a woman, ...lia Fiske, of ...Md.

The Smallest Fountain Pen in the World. It is Two Inches Long

THE fountain pen shown in the accompanying illustration might well be used to exemplify the slogan "Perfection in little things." It was made as a tiny sample, by a prominent fountain pen manufacturing company, and is as perfect in every respect as the pens of usual size. It holds only a few drops of ink, but while the ink lasts, the pen can be used to very good effect.

It is provided with a pocket clip that is perfectly able to perform its duty, regardless of its diminutive size. It is carried in a box with its own little filler, and the printed directions for its use just exactly as if it were being offered for sale like its big brothers.

A tiny pen which writes as perfectly as its big brothers

Seeing the Stars from the Bottom of a Well

THAT stars are visible in the daytime from the bottom of a deep shaft or well has been generally believed since the days of Aristotle, but there is not the slightest foundation for the idea. Baron Humboldt, who spent a good deal of time in mines himself and questioned miners in various parts of the world, found no evidence in support of this belief, and it has since been thoroughly exploded. But like many other "exploded" ideas it flourishes just as vigorously as ever.

Fireproof Leggings for the Foundry Worker

THE foundry is the one workshop where old shoes, such as the workman loves to don for the sake of comfort, are not worn —or should not be. They offer too little protection against splashes of the molten metal. Usually a Congress shoe of specially prepared leather is worn, over which a legging is fitted to protect the leg and knee.

A very good type of legging for the foundry is shown in the accompanying illustration. It is made of asbestos in the shape of a boot and covers not only the leg and knee but the top part of the foot as well. It is held in place by steel bands which fasten round the leg with spring clasps. Structural steel workers riveting white-hot bolts into big beams need not worry about exposed legs when they are so well protected with asbestos leggings. Men who use the oxy-acetylene flame in confined spaces would find the leggings convenient.

Asbestos leggings protect every part of the foot, including leg and knee

Photos © Western Newspaper Union

How the German mask protects the sniper as he lies prone on the ground

The cut-out on the side of the mask is to enable the wearer to use a rifle

The Latest Thing in German Sniper's Masks

A HEAVY metal mask captured from the Germans by the Canadians on the western front attracted considerable interest in army circles. It is made of one quarter-inch Krupp steel and although it is not much larger than a man's head it furnishes ample protection for a sniper lying prone upon the ground.

The cut out on the right of the mask permits a rifle to be held to the shoulder in the natural position. Note the peculiar sloping eye slits. Evidently they were cut this shape to conform to the angle of the eye as the sniper turns his head to peer through either of the slits, which are so far apart that only one at a time can be used. It has been suggested that a whole army of fighters should be equipped with masks of a similar nature, to reduce the very great number of head wounds. This is obviously impracticable.

© Brown and Dawson

Lieutenant Muller operating his stenographic machine. The ten keys are shown clearly at the right

A Blind French Soldier Invents a Stenographic Machine

LIEUTENANT MULLER, a Frenchman blinded in the war, has invented a machine for blind stenographers. It promises to simplify the work of teaching stenography to men who have been deprived of their sight, thereby providing them with a means of earning a livelihood.

The machine is constructed for a phonetic system of stenography. The signs are expressed by raised points, each sign representing an entire syllable. The keyboard is divided into two parts, five keys for the right hand and five for the left. Thus the initial consonants of the syllables are written with the left hand and the final consonants with the right hand. One motion writes a syllable. As no distinction is made between certain consonants, such as T and D, F and V, Ch and J and other combinations of consonants such as Br and Pr, Pl and Bl, Cr and Gr, each consonant does not have to be indicated. The Muller machine has ten consonant signs, fifteen vowel signs and three final consonant signs which make, altogether, twenty-eight signs.

The usefulness of the machine is greatly enhanced by its size and weight. It is small enough and light enough to be carried in a valise. The paper is fed through the machine from a large roll. The signs are embossed on the strip of paper by the pressure of the keys. When the blind man wants to read his notes all he has to do is to pass the paper tape which has unfolded from the reel, through his fingers.

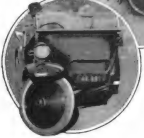
Lengthening the Period of the Comb's Usefulness

KEEPING the comb in a sanitary condition is not so easy a task as it would seem. Merely washing it with soap and water has little effect. A reliable comb-cleaner is needed. The cleaner shown in the accompanying illustration is the invention of A. Abraham, of Rockford, Ill. Its strings are of steel, covered with twisted brass wire, which is just rough enough to scrape the sides of the teeth and the intervening bottom spaces, without making the teeth themselves rough.

The cleaner will not be out of keeping with the prettiest dressing-table articles

The framework is finished in various styles. Some of them are nickeled, some are finished in copper and some in oxydized brass.

A Hybrid Between the Automobile and the Motorcycle



The "Sociable," in appearance, is much like a cyclecar, but there is little in common between the two

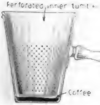
IN an effort to combine the comfort and stability of the automobile with the economy and lightness of the motorcycle, Alfred A. Scott, of England, has invented the small three-wheeled car which is shown in the accompanying photographs.

The "Scott Sociable," as it is called, looks more like a cyclecar than anything else. Technically speaking, however, there is little in common between the two. The one is nothing more than a high-seated motorcycle with a sidecar attached to it. It is uncomfortable and is liable to skid and tilt on making a sharp curve. The "sociable," however, is designed as a complete unit by itself. It is mounted on a rigid, triangular framework and its seats are carried low inside of the wheel base, so that stability is gained despite its wonderful lightness.

Practically every part has been given special attention. The caster wheel method of steering has been perfected until it can turn the car in the narrowest roads. All of the wheels are detachable. The springs are of a new type which is far ahead of any on the average light car in the way it absorbs unusually violent shocks. These springs are also detachable and can be readily replaced. Inside the car there is every approved type of accessory and appliance. Not the least of these is the hood which can be erected over the driver and his passenger in a storm.

The Bachelor's Coffee-Brewer. It Makes One Cup at a Time

NOW comes the coffee-brewer, a device for making individual cups of coffee. The device consists only of two cups somewhat conical in shape, one of which fits into the other. Sufficient pulverized coffee is placed in the bottom of the outer cup to make one cup of the beverage. Then the perforated inner cup is set in place and boiling water is poured into it. It is left to "draw" for a few minutes, just as in the preparation of tea; then it is poured out into the waiting cup. The perforations in the inner cup of the device, strain the beverage.



The bachelor's coffee-brewer is simply a perforated cup fitted inside a holder

The Powder That Sends a Sixteen-Inch Shell

Twenty sacks that will later contain the powder charges for sixteen-inch shells are cut in one operation with an electric cutter

Sewing the sacks together is as important as it is tedious. When finished, each sack must undergo a rigid examination

Canvas sacks are used to contain the igniters that are placed at the bottom of powder sacks. The sewing is done by women who are fast workers with the needle

Women also fill the igniters that explode the charge behind the shell. The powder is ...mped down solid by the sticks which they hold. This work is not as dangerous as it looks.

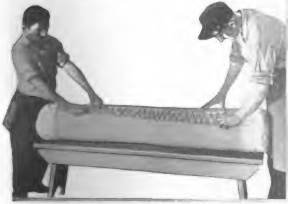
On Its Way Is Packed in Canvas Sacks

© Photo by Kadel and Herbert

Before the powder containers are sent to the various battleships they are tested with compressed air to prove their strength

Weighing the powder is absolutely necessary, for each charge must contain precisely the same amount

At right: Filling the bags with powder. Each bag contains sufficient powder to hurl a sixteen-inch shell through space at the rate of over 2000 feet a second



Lacing a powder sack is the last operation. It must make a compact bundle to avoid friction

The completed sack—it holds just enough powder to propel one shell

A Leaf of Havana Tobacco Is Heir to Mor

A typical West Indian drying shed. During the drying stage the tobacco grower is constantly on the anxious seat lest a drought shrivel up the leaves or a heavy rain cause them to sweat and become gummy. The shed has to be constructed so that it may be quickly opened or closed according to the changes in the weather, which is often uncertain

Photos © Brown and Dawson

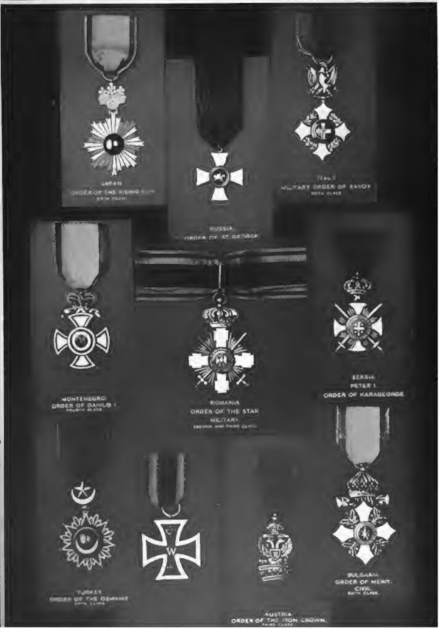
The very best grade of cigars, the clear Havana, is produced entirely by hand, just as it was two centuries ago. One man can make about one hundred and fifty cigars a day and he is paid by the piece. But no cigarmaker in Havana will work unless a man is employed whose duty it is to read aloud each edition of the daily papers. All the local and general news must be read, as well as the continued stories

Collecting tobacco leaves under a covering of cheesecloth. The direct rays of the sun make the leaves small and heavy bodied. To produce large, thin, silky leaves for cigar-wrapper purposes, the plant must be protected by cheesecloth or a latticework of lathing

"Barn cure," or the drying of the green leaves, is the most painstaking task of all. The leaves are strung about an inch apart on poles or strings, which are hung up in barns, tier over tier. Good ventilation is necessary to prevent stem rot and sweating

Patron saints and national ideals enter into the symbolism of these medals, awarded in recognition of distinguished service

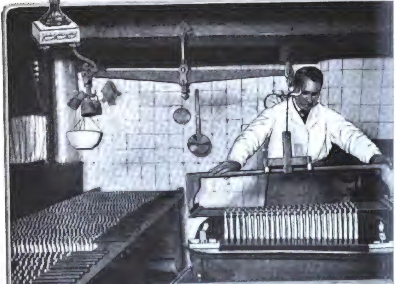
"Well Done, Thou Gooc



and Faithful Servant”

The American Democracy has only two distinguished service orders. A few famous foreign medals are also shown below

The Largest and Sr
Candle Factories in the
Are Situated in Hollan
They Are Turning Out

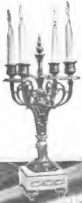


Photos © Brown and Dawson

Above: Suspending the candles in their bath by means of a scale. This enables the workman to withdraw them quickly or dip them just the right length

When the wicks have been cut the proper length they are fastened to sticks and then dipped in grease until the right thickness is obtained

Age-Old Product with an Utter Disregard for Electricity or Any of Our Modern Manufacturing Methods



The smallest candle store in the world is shown above. Candles are stored in crates hung from the roof. The shop is located in Amsterdam, Holland

The [illegible] factory in the world, at Gouda, Holland. It has an output of hundreds of thousands of candles a day. Note the way they are packed

Making a Dangerous Glacier of the Canadiar

Climbing over a serac or pinnacle of the great Illecillewaet Glacier. John R. Bell, of New York, is hanging to the rope. He takes desperate chances, not for fame or for the love of the sport, but in order to get a good position for his camera. No one can "double" with him. He has to take the chances involved in hazardous motion picture work

Rockies Pose for the Motion Pictures

The newspaper photographer is seen perched on an overhanging ledge of ice, above a dangerous precipice 100 feet deep

Photos © Press Illus[illegible]

Above, Byron Harmon and Arthur McAllister crossing a deep crevice in the glacier, with the aid of their Swiss guides

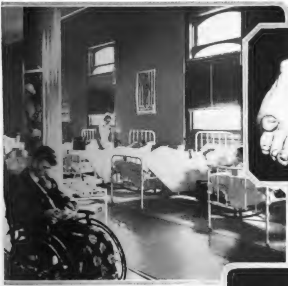
You Don't Have to Be Born Perfect to

Our country's navy rejected you, Oscar, on the strength of your varicose veins which we show below. Even the United States army did not want you at first. But they operated upon you in one of the New York hospitals and, behold, you are now wearing the service uniform of Uncle Sam

A scene in one of the New York hospitals which has over for their country's service. Young men who are some physical defect are given free treatment in many fellows in uniform and good spirits, too, for they

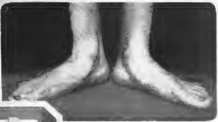
His right collar-bone (it's the left in the picture) was broken, and it was b bar and perform gymnastics better than most editors we know. And so I

Wear a Uniform—You Can Be Made Over



Not a marching foot—but the owner of the overlapping toes will shoulder a rifle. His feet are normal now. One of New York's hospitals saw to that

devoted a ward to the work of making men anxious to serve but are hindered because of hospitals. This work has put a lot of young feel better now than they ever did before



set. But he could "chin" himself on the horizontal now serving his country as a fireman in the Navy

He had flat feet—that's obvious. According to the medical rules he must be rejected. So they tested him. He hopped seventy yards on the toes of each foot. That was enough for Uncle Sam. He's in the Navy now

A Doll Factory Looks Like a Dissecting

Most dolls come in sections, as pictured below. Here, the trunk, arm and leg halves must find their mates before they are glued together for life. After they have been properly joined the rough edges must be smoothed off

Photos © Press Illustrating Serv

The workman above is dipping the trunk of the doll into a solution which gives it a flesh-like tint and waterproofs it at the same time. Hanging on a wire at the right may be seen some disjointed arms, fresh from the dipping operation. Dolly now is impervious to baths

Dolls are famed for thei peach-blow complexions The secret of these per fect complexions is di vulged here. A workmai sprays on the delicat color with air. What pity that the human skii can't be treated in th same way; and be given lasting rosy bloom. Eye brows and lips are nex painted on and then th eyes are placed in positio

Laboratory—But Don't Tell the Children

On the table above, the parts of the doll-to-be are beginning to assume familiar shape. The legs, at any rate, have found their mates and all that remains to make them passable is some very careful smoothing and polishing

A doll with a bald head is worse than no doll at all. Below, a bisque doll is receiving her crowning glory at the hands of a woman worker who does nothing else all day long but put the right shade of hair on the right doll

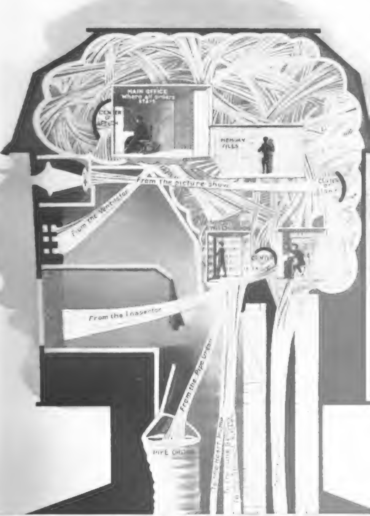
A collection of dolls, with 'Rastus, the human chocolate drop, thrown in for good measure. Dolls in winter dress sometimes make large money for their makers, because the head is left hairless and a woolen cap which costs little, is substituted

What Happens to the Food We Eat?

The above illustration shows the adventures of an egg, a piece of lean meat, some potatoes and a slice of bread during the process of becoming proteids, starch and fats. The egg and meat are shown just as they come to the "mill," unground, although of course we grind everything that comes into the "mill." The bread and potatoes begin digesting at once. The other food is slower, needing preparation in the first kitchen before passing to the second kitchen where the bile and pancreatic juice complete its digestion. As this food passes along that tube the little tentacles in its walls sort out what is needed, the waste going into the sewer. It takes two hours for food to digest; so we should not overcrowd our stomachs

(From a drawing by Prof. and Mrs. Winfield Scott Hall in Pictured Knowledge. Compton-Johnson Co.)

Is Your Brain Completely Furnished?



"As a man thinketh—so is he." This illustration shows how all movements and functions of the body are controlled from the head. The brain conducts a busy telephone exchange, with a central office and many branches. Whether you want to walk or to sneeze, to sit down or just to go on breathing, the order must come from "the man higher up." Then, over the wires go instructions to the hands, legs or lung bellows. There is an independent switchboard which governs so-called involuntary action. You can easily locate the memory files, the picture show, and the ventilator. But can you find love or hate, fear or joy anywhere about the premises? "Where, oh where is fancy bred? In the heart, or in the head?"

(From a drawing by Prof. and Mrs. Winfield Scott Hall in Pictured Knowledge. Compton-Johnson Co.)

Below: A tall board fence screened the little community from curious eyes

No one but the builders saw these houses until all were completed

Whetting Public Curiosity—A Real Estate Dealer's Ruse

AN unusual method of building houses was adopted in a real estate development in Portland, Oregon. The builder believed that "familiarity breeds contempt." As he did not want anyone to have contempt for his houses, he corralled them until they were all done. As soon as he began building, he erected a tall board fence all around the property. The most curious person could not get a peep in. No doubt he saw to it that there were no knot holes.

This arrangement had all the elements of surprise which the public enjoys in attending the theater. Not until the houses were complete to the last little detail; not until the lawns were green and the shrubs all planted; was the order given to tear down the forbidding fence.

How a newsboy saves his voice and yet "calls" his papers most effectively

How a Los Angeles Newsboy Increased His Business

AN ingenious newsboy in Los Angeles, California, has devised a method of attracting attention to his wares which has not only interested passing persons but has been the means of sparing his voice, while greatly increasing his daily income.

The boy has constructed a sign, which is placed above his head so that it may be seen by persons who are at a distance from him. It is fastened to a wire, which is held in place by a belt which he wears around his waist. He has arranged two loops of wire, through which he passes his arms. This keeps the sign from falling either backward or forward.

Sweat Bands Use Fifty-Five Million Feet of Leather a Year

LOOK at the sweat band in your hat or cap. It is about two inches wide and twenty-five inches long—a little thing, you say. It takes an annual total of fifty-five million feet of leather to put this band in the headgear men wear. It is, in truth, one of the biggest little leather leaks brought to the attention of the public. But it is not a difficult leak to stop. By wearing hats or caps with substitute leather bands or no bands at all, you can divert the leather to more important needs.

Clearing the streets of London with an illuminated warning carried by automobile. After the danger is past, the reverse side of placard is shown telling that the way is clear

Protecting the Phonograph from Scratches During Transportation

THE phonograph cabinet is designed to be as ornamental a piece of furniture as the piano. The dealer therefore, realizes the importance of handling it with care. One company is employing a khaki moving-cover which is so designed that it makes the cabinets easier to handle and protects them from any danger of scratching, bumping or finger-marks.

This khaki cover is shown in the accompanying illustration. It is provided with strong straps into which the arms of the carrier fit, and other straps which pass under the cabinet.

There is also a loop by which the cover may be hung up when not in use.

Protected by its khaki cover the cabinet can be moved without danger of being marred even by finger-marks

The Paul Reveres of London Ride in Placarded Automobiles

ENGLAND has had so many air-raids that special provision has been made in the large cities to warn the people when the enemy airplanes have been sighted.

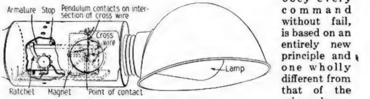
The illustrations show placarded automobiles sent out to give the warnings. The side lights are used to illuminate the signs, so that he who runs may read and get under cover. In a few minutes after the invading airplanes have been sighted, the streets of the city are without a sign of life. If a person should be at too great a distance from shelter to reach it, he drops to the ground. The signs are reversible, and on the opposite side of the "Take Cover" placard, the "All Clear" sign is displayed.

Maybe you have special needs. Write to the editor about anything within the scope of the magazine. He will be glad to help you.

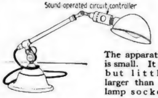
Clap! Let There Be Light

By clapping your hands you can light up the whole house. No, there is no microphone to hear the sound

SUPPOSE that you wished to light the electric light in the library while you were in the living-room and that you could do so by the clap of your hands. Or, on coming home at night, suppose that you could light your way by the same means without hunting for the electric light switches in the dark.

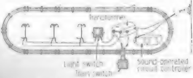


Noise of hand-clap jars a small pendulum away from diaphragm and breaks the relay circuit

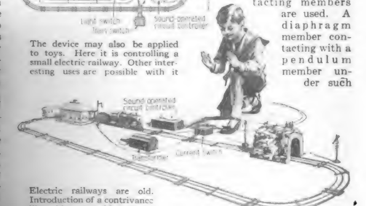


The apparatus is small. It is but little larger than a lamp socket

But what's the use of supposing? Mr. H. Christian Berger, a New York city inventor, has made all such things possible by inventing a new contrivance which he calls a sound-operated circuit controller. Besides the utilitarian uses to which the device may be put, it may be employed for the operation of mechanical toys of various sorts, including electric railway trains, electric boats, hoisting derricks, or even the docile little wooden pup who jumps out of his kennel at your ... com- ... toy ...d in ...wer, ... of ... ...he ...pup, ...ned, ...irly ...oca- ...uld ...be- dient and refuse to come out of its kennel, because of the variable current changes of the microphone mechanism, by which it was operated. The new means which Mr. Berger has invented to make the dog obey every command without fail, is based on an entirely new principle and one wholly different from that of the microphone. While the latter acts by varying the electric resistance and current in a circuit by changes of pressure and conductivity as a result of the action of sound waves—and does not break the circuit—the sound-operated circuit controller actually does open the circuit. These circuit breaks are made possible because two contacting members are used. A diaphragm member contacting with a pendulum member under such



The device may also be applied to toys. Here it is controlling a small electric railway. Other interesting uses are possible with it



Electric railways are old. Introduction of a contrivance like this one adds novelty

slight pressure that it is capable of bodily vibration by the energy of sound waves.

These two members may be employed in a circuit with a relay or other magnet whose armature is acted upon by a constant counter force or spring, the force of which may be regulated to move the armature beyond the operative influence of the magnet, or not, as desired. In the case of the toy dog, the force of the spring is such that the armature is thrown beyond the influence of the magnet so that the dog must be put back into his kennel by hand and placed up against the magnet bar before he is again ready to be clapped out.

With the electric train, the magnetic armature, instead of closing a relay circuit on each actuation serves to reverse it.

Sharpen Your Own Shears and Save Your Time and Temper

THE new grinding device, shown in the accompanying illustration, is designed to enable the barber, in a small town, to sharpen his own shears. It makes it unnecessary to send many dulled shears to a barber's supply house at a distance with the resulting delay. The new device is portable and may be screwed to the edge of any table, where it is ready to be used.

Barbers may now sharpen shears with ease and sureness of result

The contrivance consists of a small grinding wheel mounted on a vertical shaft. A crank and worm gear supply the power. The pair of shears is held in a clamp at the top of the wheel, as shown. The clamp slides on a metal rod so that the shears may be drawn across the face of the grinding wheel as it is revolved.

A Horn of Natural Rock. It Can Be Heard Six Miles

"KING ALFRED'S Horn" is the name applied to a great shapeless block of stone in the Vale of Berks, England. It is pierced with a number of holes. By applying his mouth to it and blowing as into a horn, the practiced performer can produce a weird, booming sound, said to be audible for a distance of six miles. The story goes that King Alfred used this natural horn to summon his forces for a great battle, fought in the immediate neighborhood.

The Trunk-Smasher Is Foiled at Last by the Rubber Mat

NO matter how strong and well built a trunk may be, it will not long survive if the average baggageman gets a chance to "strafe" it. A Los Angeles man would get around this by providing rubber mats for trunks to land on.


Trunks land on rubber mats in Los Angeles. A local man makes the mats of old garden hose

According to his plan, the mats may readily be made of heavy garden or other hose held together by a pair of rods. Using these mats, the baggageman may handle trunks with his usual roughness without injuring them.

Where New York's Bond Money We

The huge safes of the Federal Reserve banks are proving most convenient in con erving all the Liberty Loan funds

Photos © Brown and Dawson

It takes both officers and clerks of a Federal Reserve Bank in New York city to get this door open. Each knows part of the combination. The safe also has a time lock

The fifty-ton weight of the door does not prove difficult to manage—one man can easily swing it open. But when the combination is "off" not even the Kaiser could get in

THE door in the picture weighs fifty tons. It guards the treasure of a Federal Reserve Bank—this particular one being in New York city. Liberty Bond money accumulates in Federal Reserve banks temporarily. The outer rim of the safe—up to the place where the bolts are placed—is constructed of manganese steel, which is particularly difficult to drill and which will not rust readily. When closed, the door fits so snugly that it is absolutely watertight.

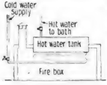
There are two combinations to the door. One is known by the officers of the bank and the other by the chief clerks. It is impossible to open the vault unless a man from each group is present. Four time locks control the mechanism. Once the time is set at which the door can be opened, it is impossible, even for anyone knowing the combination, to open it earlier. Hence if the tim is set for eight o'clock i morning no one could op door during the night. longest time for which the locks can be set is sevent hours. This allows the do be locked from Saturday over Sunday and any ho which might fall on Mo

Each of the bolts set r the door weighs ninety-five pounds. T slide into place when the door is sh securely fastening it at every point. T door is hung on its hinges in such a m ner that despite its great weight it be swung open or shut as easily as a ordinary wooden door. It is not o designed to thwart the skill of the expe enced cracksman but to withstand t terrific heat and blows which accompa fires and earthquakes. After San Fra cisco lay in ruins, an early investigati of the big safety vaults brought out the assuring fact that the contents were sa and intact.

The Federal Reserve banks have prov an almost indispensable aid to the floati of the Liberty Loans. They act as gre central "warehouses" for the storage funds, and also exert a stabilizing effect banking and financial operations.

Unaccommodating Wells—They Yield Water Only at Night

IN the desert of western Australia there are wells which yield water only at night. Before the water begins to flow, weird hissings and the sound of rushing air may be heard. The phenomenon is believed to be due to a change in the form of the rocky channel through which the water flows, and to the extreme change in temperature between day and night which occurs in this region. The hissing is due to the escape of air before the advance of the water.



Using an old hot-water tank, pieces of pipe and other scrap metal, plumber-soldiers in the Eighth Pennsylvania constructed a shower-bath for themselves

At Each Turn of the Crank, a Cartridge Slips Into Place

AN automatic machine-gun can discharge the two hundred and fifty cartridges of a fully loaded belt in less than twenty-five seconds. The loading of the cartridge belts is, in comparison, a leisurely occupation. To slip two hundred and fifty separate cartridges, by hand, into their individual loops in the cartridge belt, is tedious and expensive. To expedite matters, the little loading device, here illustrated has been evolved.

Layers of cartridges, as they are removed from the standard box of cartridges, are slipped into the vertical guide, the belt entered between the feed-wheels of the loading device and the crank turned, just as one would operate the handle of an ice-cream machine. The cartridge belt issues on the near side with a cartridge properly inserted in each successive belt loop. In a very few minutes the belt is fitted with its complement of two hundred and fifty cartridges, and *is ready for immediate use.*

What is the man doing—sharpening pencils? He is not. He is loading a machine gun cartridge belt with rapidity

Plumbers Will Plumb—Even in Army

IN the Eighth Regiment, Pennsylvania Infantry, there are plumbers. Plumbers will plumb even if they *are* in the army and can't go back to the shop for tools. Ingenuity always takes the place of implements, as it did in this Eighth Regiment.

A few old pieces of pipe, some brick, a tank, and odds and ends, were all that was needed to rig up a shower bath for fellow soldiers. How the parts are put together is shown in the illustration. Hot or cold water may be had as desired. Real mortar is used in the furnace's construction, and over the whole is a coating of mud to help keep in the heat. Fresh water enters through the coils next to the fire and is made hot as fast as drawn out through the pipe leading to the bath.

The soldiers may retire to this improvised bath room at any time and enjoy a hot shower. A fire of old fagots, pieces of coal, or anything available, will keep the water warm for a long period.

Speaking Tubes for a Ship's Gunners

Reporting the range, the hits and the misses

Photos by Naval Constructor Elliot Snow, U. S. A.

IN a naval battle, the range is obtained principally by men stationed in the mast tops. The readings of their instruments are telephoned down to the officers in the plotting room, below the warship's deck. Here the instrument readings are quickly transcribed into terms of gun ranges and of angles of horizontal deflection. These calculations

© By U. S. Naval Institute

A receiving and transmitting headset as well as a speaking tube is shown at right

Above: A torpedo tube operator with the voice tube [illegible] board

A sight-setter's voice tube equipped with a megaphone attachment, at the left

either a voice tube or a telephone is likely to be swept away. In big battles, the gun that

[illegible] make [illegible] good. [illegible] est, has but one channel of communication stands grave chances of being cut off from the rest of the ship. Should that happen,

the gunners would have to depend upon the gun's telescopic sights, and there would be no checking up of hits or misses by the spotters in the mast tops.

Thus, the means of communication is the crux in the modern method of pointing and firing a battleship's guns. In our Navy, voice tubes are generally preferred to electrical apparatus. Speaking tubes are just metallic pipes made airtight.

Why Do You Laugh When You Are Tickled?

ALTHOUGH it is usually done in fun, the habit of tickling is supposed to be a somewhat dangerous one, according to physicians. The ticklish areas are located over the least protected parts of the body, where delicate vital organs are to be protected. The reason for the ticklishness is that the skin is highly sensitive there and "aware" of intrusion, as a means of protection from possible injury.

This sensitiveness, or awareness, the physicians say, is a relic of the days when man's prehistoric ancestors had to guard their lives constantly against creeping insects and the heavy penetrating pressure of animals' teeth. That is why, according to this theory, the tickle reflex is elicited principally by a light running motion over the skin, and by sudden prods.

The reaction, in this age, is a violent discharge of energy in the form of laughter and efforts to be free. But it is easy to imagine the shrieks of terror or pain that might have been the forerunner of the laughter. Humanity takes ages to outgrow its prehistoric impulses.

The Liquid Fire of the Trenches Is Not as Deadly as It Looks

THE effect of jets of liquid fire on men in the trenches is more terrible to the eye than to the body. But despite this fact, it is still used as a weapon. The bulky, rectangular tanks found in the original outfits have been replaced by the less cumbersome and more efficient "life buoys" and "bombs" of the latest flame projectors. In operation, the Germans let out the gas under compression, so that it forces a stream of combustible oil from the buoys through a connecting line of hose. The oil, which travels fast under the great pressure, passes a lighted wick in the nozzle of the hose. The burning jet is then directed toward the enemy.

From Illustrated War News

The highly compressed gas in the "bomb," on being let out through the "buoy," forces out the combustible oil with it

But improve their apparatus as they may, the Germans have no control over the action of the air. By lying flat at the rear of their trenches, the men, being attacked, are in little danger. It is the German soldier who has suffered most from fire. The British, in self-defence, have combated liquid fire with the flaming shell. This, as explained in the October issue of the POPULAR SCIENCE MONTHLY, does not ignite until it hits the ground. If the guns are pointed so that the shell strikes just in front of the trenches, both flames and débris will shower over the enemy troops. Moreover, the British have found that by firing at the enemy's tanks, these are often exploded, killing their operators in the action.

Blindfolded recruits learning speed in laying wire entanglements by the sense of touch

Training "Tommies" to Lay Wires in the Dark

IN efficiency tests, conducted at Aldershot, England, the recruits are drilled in every requirement of military tactics, under conditions such as they are likely to encounter in the war zone.

The accompanying illustration shows a wiring party, sent out to set up wire entanglements, presumably under cover of darkness. In order to train them to be sure of step, even when the way is obscure, the soldiers are partially blindfolded. Even so hindered, they work rapidly over rough, undulating ground, such as they will find on a battle field.

Moving a Piano by Automobile

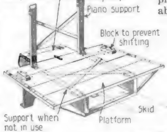
A NOVEL type of platform has been designed by a Nebraskan inventor, to carry a piano so as to properly distribute its weight over all four wheels of a Ford roadster.

The platform is made of two longitudinal wood members curved at the front to fit the rear end of the Ford seat, and held in place by means of bolts through the top and bottom flanges of the Ford side-frame members. It is suitably cross-braced and has side brackets by means of which it is attached to the runningboards to secure greater rigidity.

The platform is made of wood, reinforced with angle-irons on the edges, and near the front it has two hinged boards, which are raised to a vertical position when a piano is carried.

The piano is placed transversely of the Ford with the keyboard at the rear. It is held in position by means of two leather or canvas straps, inserted through loops in the tops of the two hinged boards and then carried back to the rear of the platform, and by means of an additional leather strap, inserted in the angle of the keyboard, and attached to the front ends of the platform on either side.

Since the weight of the average piano is approximately 350 lbs., or about equal to that of the three passengers usually carried in a Ford touring model, no additional strain is placed on the vehicle. The piano is placed directly up against the two hinged boards so that it can-



Another use for the little Ford. It will move your piano for you

not slide while the vehicle is in motion. Its center of gravity is well forward of the Ford rear axle in order that its weight may be partly distributed over the front wheels.

To load the piano onto the platform easily, two stout plank skids are provided. These have angle-iron hooks on their forward ends, which slip into staples bolted to the rear of the platform. After the piano has been loaded, the skids are removed from the staples and pushed forward under the platform, so that their overhanging ends do not present a menace to pedestrians.

In this way the piano is as safely moved as in a fully equipped van.

Lo! The Electric Blanket. It Always Keeps You Just Warm Enough

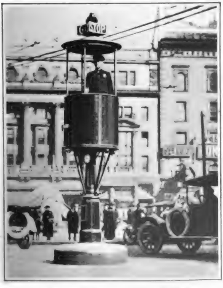
SLEEPING out-of-doors has been robbed of its most unpleasant feature—the chill. No longer is it necessary to shiver with cold, or to pile uncomfortably heavy bedclothes over yourself.

This electric attachment makes one blanket sufficient for the coldest night

An electrician has devised a light blanket which is electrically heated. The blanket is equipped with three heats, so that you can have it mildly warm, warm, or almost hot, with the expenditure of but a small amount of current.

No Passing Traffic Can Interfere With This Policeman's View

A PERMANENT nest of wood and iron construction, standing more than fifteen feet high, at the intersection of six streets in the busiest part of Detroit; will be used by a policeman, to direct traffic going in twelve directions. In this nest the officer is high enough to see several squares each way, which enables him to avoid confusion and accidents. The station, which is glass enclosed and heated, has a signal equipment, so that it can easily communicate with nearby busy traffic posts.



An elevated policeman's nest, with the direction indicators in clear view of all

What Causes the Singing of Telegraph Wires?

THE singing of telegraph wires is sometimes regarded as a weather prognostic, though opinions differ as to the kind of weather it foretells. There has been much discussion as to the cause of this sound. Probably it is simply the Aeolian harp effect, and its occurrence depends chiefly upon the direction of the wind in relation to the direction in which the wires run. Variations in the pitch of the sound depend upon changes in the tension of the wires with varying temperature.

Attaching and detaching the adjustable gun-locks

You Can Be Your Own Gunsmith

JUST about the time the merry gunner is afar from gunsmith and factory, and the ducks are coming in, his old fowling piece decides to take a vacation, and a lock quits. Maybe it is rusty through long neglect, maybe a firing pin has become gummed up, maybe a mainspring breaks. A seance by marsh, particularly salty marsh, or seashore, is likely to start a coat of rust on the damaskeened surface of the locks of a fine gun; or a primer may leak and let in gas, which starts rust also.

A British maker has evolved easily-detachable locks for the hammerless gun. Take off the fore-end, press back a catch, and the bottom plate in the frame of the gun drops down on a hinge, exposing the two fine locks of the hammerless gun, the main and sear springs, the sear, and the striker and tumbler of each lock. Only a moment is required to wipe them off, oil them and slip them back into the gun. Or if new parts are required, the maker furnishes them in a neat leather case. If anything should break, merely take out the old part and slip in the new.

Using Snow for Cement and Ice for Windows

FIFTY degrees below zero is the average temperature in the south of Siberia during the winter months. In the section of the country where the house shown in the photograph was located, the weather is comparatively mild. In fact, although the logs of the house were cemented together with snow, there were times when repairs were necessary on account of the snow melting from the heat of the interior. The windows, too, which were of sheets of ice, had to be renewed at least once in every four months.

...able residence in Siberia. The roof is of mud, the windows of ice, and the logs ...nted together with snow. If a sudden warm snap occurred the house would collapse

Weighing Goods Automatically

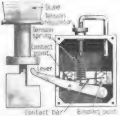
A machine that insures
the merchant against loss

IN putting up package goods such as sugar, coffee and rice there are two sources of loss. One is undue waste of time in weighing the contents by hand filling, and the other is due to giving overweight.

Consider first—the weighing by hand. A good clerk can weigh only five or six packages a minute, and experiments show that each of the packages contains a "present" for the purchaser, of half an ounce or less of the commodity.

When the desired amount has been weighed out, an automatic cut-off is operated which prevents waste

Some merchants have tried the plan of setting the scales to weigh short, trusting to correct the overweight in this manner, but this is by no means accurate. This was proved by a test in a large grocery where that system was tried. Out of two thousand packages reweighed, it was found that over ninety percent ran overweight. Less than five percent showed underweight, although the scales had been set two ounces short.



How the weigher works automatically

An electrically-operated weigher has been produced to overcome this defect. It handles from fifteen to twenty-five weighings per minute. Its features are an even balance scale, agate mounted, a mechanical cut-off, tripped by electricity, which cuts off the flow of the commodity in full stream and a control box which allows for the amount in suspension; that is, the amount in the air at the moment the cut-off is operated.

The weight plate of the scales rests upon the lever, which is thereby depressed, and the electrical contact is broken. When the goods approach the weight required, the tension of the spring causes the weight plate to be raised a bit prematurely and contact is made by which the electric circuit is completed and the cut-off tripped.

All of the parts are made of the highest quality of metal, to prevent inaccuracy due to wear. The tension screw is adjustable, so that it can be regulated to allow for all conditions, even for weather, which might cause a variation in the flow of the commodity. A test weight is used and then the standard of accuracy is divided into three parts, high, low and exact balance. The machines are self-testing, so that the need of adjustment is quickly made evident, and their regulation is easily accomplished even by an unskilled operator. Thus extreme accuracy as well as high speed in weighing package goods is secured. On the other hand, automatic weighers of many designs allow for practically no inaccuracy.

Dolls Become Screen Idols

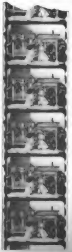
They never get stage fright and they don't talk back

HARASSED motion picture directors may be relieved to know that there are stars who will do exactly what they are told to do without complaining. These quiet, obedient actors are dolls. Yes, dolls have not been able to resist the lure of the screen.

They are just the ordinary, little dolls such as any child would like to have for playthings. A special stage and scenery is constructed for them. They are put through the poses which make up a real drama. The work is tedious and requires any amount of time. The dolls are posed and a picture is taken. Then they are moved a fraction of an inch to a different position and posed again. The camera takes another picture. When the work is finally done, the dolls appear to move across the stage with all the rapidity and ease of motion of real actors.

Photos by Peter Pan Film Corp.

Here we have a kitchen romance acted by dolls. The cook is embraced by her sailor sweetheart much to the horror of the butler



The plays which they act in are not meant to appeal only to children. The dramas are well thought out and clever enough to interest any motion picture spectator. But as the work of posing them is so very slow, a scenario played by dolls is, in some ways, more difficult to put on than one played by human beings. It often takes several weeks to make a short play. For example, if a scenario called for a real actor to throw his arms about the leading lady, the actor would be able to go through the motions in one or two seconds. This would be recorded on one or two feet of film which would comprise from twenty-four to thirty-two pictures.

When the same scene is acted by a doll it requires from twenty [illegible] thirty minutes, even at fast work; for the doll actor can be moved only a fraction of an inch at a time. The director must understand just how to make his toy actors move in a realistic manner. In other words, he must have studied and been a keen observer of human motions. When we see a man step up on a chair, the step is taken in one swift movement. If a motion picture doll steps up on a chair, this step requires a whole series of movements. The doll is posed ready to step up. It is then suspended by an invisible wire and raised until ready to transfer its weight to the chair. All this must be done in such a manner that the simple [illegible] othly [illegible] ork [illegible] re- [illegible] red [illegible] ago. [illegible] plastic [illegible] took the

It is tedious work putting the doll actors and actresses through their parts, but the results are worth the efforts expended. The action depends upon the number of poses taken by the figures

The sculptured figures were changed to different poses and then photographed. In other words, each time a figure moved, a new pose had to be made. Think what that meant! For the ordinary reel of one thousand feet, sixteen thousand separate poses were required to furnish the action!

Automobile Fuel Heated by Exhaust Gases in Dual Manifold

THE use of heat is perhaps the simplest expedient to which engineers have resorted in an attempt to give the automobilist the same number of miles per gallon from the present-day gasoline as that secured from the better grades, sold several years ago. Present-day gasoline is more like kerosene than the gasoline of 1912. Kerosene has a greater fuel power than gasoline, but it is harder to get the power out of kerosene than it is gasoline because it cannot be broken up into its elements and turned into a combustible gas as easily without some external means. One of these is heat.

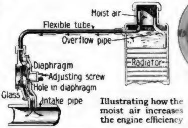
In the compound manifold, shown in the accompanying illustration, the ever-present heat of the exhaust engine gases is used to heat the incoming fuel so that its kerosene element will vaporize more readily and give up its full power. This is accomplished by dividing the manifold into two parts with a metal wall between. The exhaust passes out on one side of the wall and the new fuel comes in on the other. The exhaust heats the dividing wall so that it in turn heats the incoming fuel on its way to the cylinders, where it arrives at a high temperature and in such a highly and completely vaporized state that it gives up its power readily on its explosion. According to some reports, this dual manifold increases mileage from forty-two to fifty-four per cent, and keeps the engine explosion chamber practically free of carbon.

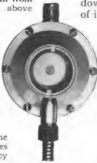
The exhaust engine gases heat the manifold wall and the incoming fuel is vaporized

A New Device Mixes Moist Air with Gasoline Fuel

OPERATING on the same principle as the diaphragm pump, the device illustrated, automatically draws a certain amount of moist air from the radiator of an automobile and delivers it into the gasoline intake manifold. The amount introduced is automatically controlled by the suction of vacuum of the motor, which draws the diaphragm of the device against a cone-shaped adjusting screw that serves to vary the amount passing through a hole in the center of the diaphragm.

The device draws moist air from the radiator, as shown above

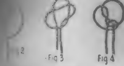




Illustrating how the moist air increases the engine efficiency

How to Tie a Steel Cable in a "Jug-Handle" Knot

IN order to splice a steel cable, it is necessary to make a knot which will not slip or untie. Cable men employ what is known as the "Jug-handle" knot. This is made by grasping the rope in the left hand and forming a loop, as in Fig. 1, with the thumb at the cross. Next bring the loop down so the center of it rests under the thumb, as in Fig. 2. Hold the loop firmly under the left thumb and turn the right half over toward the back and downward, then turn the left loop back and place it behind the strand which has been held under the thumb. The knot is now like Fig. 4. Next, place the finger and thumb of the right hand through the space marked with a cross in Fig. 4 and grasp the strand which was first held between the thumb and forefinger, in the original position. Care must be taken to grasp the strand between the two strands which are held in the left hand. Pull this strand through and the [illegible] is tied. The rope [illegible] and turn as it is [illegible] through, but it will [illegible].



[illegible] "Jug-handle" knot

Utilizing Garbage to Lower the Price of Pork

OUT in Omaha City, Omaha, the people are not worrying about the soaring prices of pork. The hotel men of the city have formed themselves into a hog-raising organization, and a chain of restaurants contributes the table and kitchen refuse to feed the hogs, fattening them for the market in record time.

In Hull, Mass., the same idea of utilizing garbage to prepare live stock for the market, is carried out under the city management. Land for pasturing and [illegible] ing is loaned [illegible] the only ex[illegible] salary of [illegible] takes [illegible] The [illegible] the [illegible]

Outdoing the Mine Throwers

Stokes gun used by British proves simple and effective in trench warfare. You drop in the shells. German "Minenwerfers" aren't in it!

A new gun and various types of shells now used in trenches

A WEAPON with little velocity but which could heave considerable quantities of high explosive into an enemy trench, was badly needed at the beginning of the war. The Germans were the first in the field. Hans worked out little trench mortars he called *minenwerfer*. Soon the British replied with the Stokes gun. This latter is now linked with the famous Lewis machine gun, the Mills and Hale grenades, and the like, as one of the most potent inventions brought about by the war.

Trench mortars and howitzers are merely short-barreled, light-shell pitching guns used for sending shells via the indirect fire route from one trench, over Deadman's land, to another trench. High velocity would defeat its own purpose, just as would direct fire. One would drive the shell entirely too far when the gun was elevated to pitch the shell, the other would merely shoot over the top of the other trenches after the fashion of a rifle bullet. In consequence, a mortar of any sort is elevated to not less than a 45-degree angle. This causes a shell to go skyward and over toward the other fellow like a deceased cat over your alley fence. The method is simple. It is effective none the less.

Taking advantage of the fact that a mortar is always elevated at an angle of 45 degrees or more from the horizontal, Wilfred Stokes worked out a shell, consisting of a case containing a large quantity of high explosive, fitted to a base filled with a light charge of propellant powder—also a primer therefor. The bottom of the gun barrel has a projection or stud inside. So when this new shell is dropped down the barrel of the gun from the muzzle, the fall bangs the primer against this stud and sets off the gun.

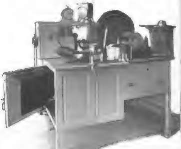
The rapidity of the fire is limited only by the speed at which the gun crew can drop shells down the barrel

Housekeeping Made Easy

An attractive aquarium hung on a tripod. The glass container is decorated with pond lilies and their leaves

A dehydrator for all-the-year-round use in drying surplus fruits and vegetables. It is set over a cook stove

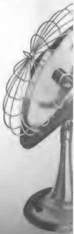
A telephone stand screen folds with a flower box



An elaborate kitchen table that is a whole workshop driven by a motor

Two perforated pans, one inside the other, for baking a pie crust without the usual filling

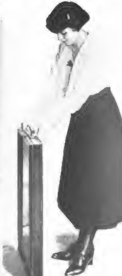
A homemade cabinet especially designed for a boarder. Shelves are provided for utensils and a gas stove plate is placed at the top



An attractive electric heater, like a lamp stand, for use in small rooms, bath and offices where a small amount of heat is required

Housekeeping Made Easy

A wire attachment placed over a faucet handle to hold a drinking glass in an inverted position

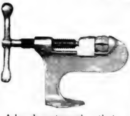


Two positions of a folding tray for use in traveling. When folded up it can be placed in a trunk

An egg cup having a jacket in which hot water may be poured to keep the egg warm for serving

Fruit properly canned must be heated while in the container. For handling the jars while hot, this holder shown at the left can be used

An auxiliary baby seat between the handles of the carriage holds the older cherub when he tires of walking



A handy nut cracker that does not crush the meat. Screw pressure does the trick quickly and neatly

The poultry man will appreciate the new oat sprouter shown at the left. It grows winter grain

French Official Photo

On the top of the hill is a lone bell, serving as a tombstone to mark the grave of the church at Les Boeufs, on the Somme River, in France. For hundreds of miles the country is like this

The Unforgettable Fact—the Murder of France's Churches

THE mountainous mass of debris shown in the picture is all that is left of a once famous church, at Les Boeufs, on the Somme River, in France. Crowning the top of the unrecognizable heap may be seen a bell which, by some miracle of good fortune has been left untouched by the retreating Germans. It is the only thing which remains to tell the story of a splendid structure, erected to appeal to man's better self, only to be sacrificed to the insatiable greed of the war god. One of the most pathetic chapters of this war is the deliberate murder of France's churches. Some of them were erected in the thirteenth century and were not completely finished until nearly four hundred years later.

The Soldier Can Now Lie Down On His Bed of Air

A NEW service bed has been designed by an English manufacturer, which will fit into a small valise when folded. It is made of a fabric strong enough to withstand hard wear. When it is to be made up, an inner casing of rubber is inflated by means of two valves. Should it be torn or punctured, the rubber can be repaired in the same manner as a tire. The bed is twenty-three inches in width, but to accommodate those who find comfort in sleeping with knees slightly raised, the knee-rests have been made seven inches wider on each side. It requires about two minutes to inflate the rubber section. When the bed is not being used, the air is discharged from the rubber section.

The mattress of this new campaign bed for the soldier is a rubber section inflated with air

Pulling Horses Out of the Mud in Rain-Soaked Flanders

WHERE is the muddiest country in all the world? Put this question to the Allied troops and they will tell you as one man that it is in Flanders, the land that was noted for its fertility and beauty before the war, but which is now the scene of desolation and plunder. The illustration shows a Tommy extricating two shell-laden horses mired in the mud. Frequently a bursting shell will cause a number of horses to leave a good road and run for the soggy fields, only to become helpless.

© Prem Illus. Serv.

Two horses, laden with the famous French "75's," being pulled out of the knee-deep mud in Flanders

With This Darkroom, Develop Your Photographs on the Spot

THE modern photographer can develop his pictures wherever he happens to be. The device that makes this possible is a collapsible dark chamber. A large light-proof cover opens at the top through which you place the trays, the plates and chemicals. The chamber is extended by a bracing which can be raised about one foot. Your arms are put through two light-excluding sleeves. Your head is brought up against a hood, and two shutters are opened automatically. You proceed with your work with ease, developing films as well as plates.

Light penetrates through the ruby glass in the cover of the collapsible chamber

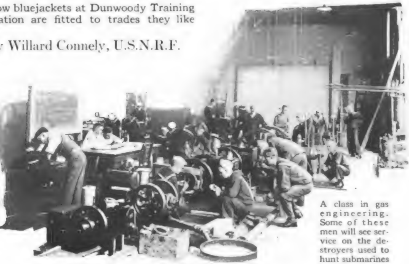
What Makes the Tumbler Pigeon Tumble in Flight?

"THE action of the tumbler is well known to nearly everyone. In its simplest form it is a single backward somersault, made in flight, and from which the bird recovers gracefully. This may be increased to two or three turns in the common tumbler or to a swift succession of four or more in the roller. . . . . That it (the tumbler) has a physiological cause, such as a defective inner ear or brain, there can be no doubt, but the problem is so clouded with what appear to be psychological questions that it will not be easily solved. At any rate the facts remain that the bird does go over, that he does it more freely at times, as when flying with his mate, and that under stress of necessity, when pursued by a hawk or striving to regain his place in the kit, he flies as well as any pigeon. On the other hand, some individuals in the bird family, particularly among the rollers, appear to lose control of themselves entirely, and having started to roll, continue until they strike some object which stops their fall. Such birds, which are known as 'roll-downs,' or 'mad rollers,' never regain the ability to fly safely once they have lost it." (L. S. Crandall, in *Pets*, Henry Holt & Co., New York.) Testing the sense of balance is the main feature of the present examination of prospective flyers.

Turning Sailors into Craftsmen

How bluejackets at Dunwoody Training Station are fitted to trades they like

By Willard Connely, U.S.N.R.F.



A class in gas engineering. Some of these men will see service on the destroyers used to hunt submarines

THE United States Government is the professor of independence in the University of America. One of his pet classes is the Navy, in which he teaches competence for life to his pupils, the bluejackets. For them he has schools on land as well as on water, from which his approved graduates may re-enter civil life awarded a degree whose counterpart is given at few colleges—the degree of Bachelor of Thoroughness.

One of these land schools is the Dunwoody Industrial Institute in Minneapolis, now a United States Naval Training Station. There, more than six hundred bluejackets and petty officers are acquiring skill in the crafts which they want to make their life work. The men are not enlisted from one community, any more than the midshipmen at Annapolis are all from Maryland. They arrive in detachments from the various recruiting centers—Detroit, Chicago, Buffalo, Richmond, Pensacola, New Orleans, San Francisco and Seattle.

Nine courses of study are offered the naval apprentices at Dunwoody; and he is an odd youth indeed who never in his life has evinced particular concern about one or more of them. In general, the classes are formed from two sorts of men. Suppose Captain Moffett, Commandant of the Great Lakes Naval Training Station, were to send one hundred radio men to Dunwoody. He first combs his roster for bluejackets who have had previous experience in wireless telegraphy and who desire to continue; second, for men who have long wanted to be operators but who have never had the chance to learn before they joined the Navy. If mental qualifications are satisfactory, the latter men are elected as well, and later graded so as not to be a drag on their more experienced mates. After a four months' course of electrical study and operating practice in the international code, these men are able to receive twenty to thirty words per minute, and can go direct to sea. In electricity, they have laboratory work, and lectures in magnetism, storage batteries, condensers and oscillating currents, spark systems, wave meters and measurements.

The bluejackets who learn to be ship's bakers probably have as much actual fun out of their work as any. With all the latest scientific mixing and blending apparatus at hand, they leisurely turn out one thousand loaves of bread a day, three hundred loaves going for the general mess

Recruits have progressed to such machines as the grinder and radial drill-press in a short time. Many were formerly employed as expert munition makers at Bethlehem and other cities

Within a month the carpenter's class knows how to build stools, chairs, tables, cabinets and benches. Some of the boys are devising schemes for the construction of dwellings

A class in coppersmithing and sheet-metal work. Pipes, conduits and kitchen utensils are made after blueprints have first been prepared and passed upon in the drafting room

A class which specializes on the study of storage batteries, magnetism and kindred subjects

and the remainder being sold to a local baker at cost. On demand, they supply a hundred apple pies or fifty chocolate cakes in the course of a morning.

"Will you run a bakery of your own after the war?" I asked one of them.

"Not much. This is no life for me," was his swift answer.

"Then why are you taking the course?"

"I want the chemistry that comes with it. I work in the chemical laboratory after hours. I'm going into the drug business after I've served my next enlistment."

Many of the apprentices are as resourceful as that, with their eyes constantly on the future. In what is called the "related work," as chemistry to baking, they have the chance to specialize as they desire. The man who wants to be a druggist made such a good record as a baker that he was advanced to an assistant instructorship.

In fact, out of every fifteen men at Dunwoody, one has been found proficient enough to earn the post of assistant instructor. On Saturday mornings these men are taken aside in special classes by the chief instructors, who give them work in theory and applied problems.

The men in the gas-engine class are learning to be motorboat pilots. They will operate the boats used by th officers in getting from one ship to in a fleet, or in going ashore from age out in the harbor.

The coppersmiths are making pi conduits, boxes and kitchen utensi all their work they first make bluep the drafting room. The assista structor here is a bluejacket from who has been in the coppersmith b for himself. When war was decla sold out his shop at a sacrifice in o do his bit in the Navy.

Not the least important of the are the cooks. To prepare the fc six hundred hard-working bluej three times a day would seem eno do, but these fifty embryonic chef scientific instruction in the classroo They are taught how to cut sides of to know the comparative food val vegetables and breadstuffs, and h compose a balanced menu.

So it is not difficult to understan the naval training course worked o Ensign Colby Dodge, U.S.N., Com ing Officer at Dunwoody, and b Charles Prosser, Director of the Inst means something more to the bluej than scrubbing the deck or polishin brass. It is the free gateway to chosen and lucrative career.

Seeing A Trillion Miles

You do it every clear night that you turn your eyes skyward and watch the stars twinkle in the heavens

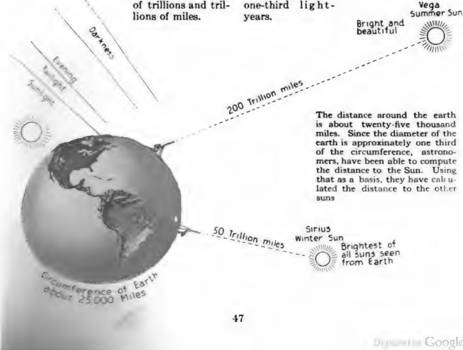
TO see a trillion miles seems superhuman, but it is done nevertheless. In one way, we can see many trillions of miles, but, as we should expect, not very clearly. We can see the Sun, and he is more than ninety millions of miles distant. Thus, when we gaze at him, we are seeing many millions of miles.

Now, most of the stars are suns. They shine and give out heat exactly as the Sun does, only many of them are much brighter and hotter than he. The reason why they do not look as large and as brilliant, is because they are so very, very far away—trillions of miles, instead of millions. After astronomers had calculated the distance to the Sun, they were able to estimate the distance to the other suns. Obviously, these distances to the stars are not accurate to a mile or indeed to many, many miles. However, it is absolutely certain that each one is at a distance of trillions and trillions of miles.

A few of the stars are not a trillion of miles away. These comparatively nearer stars are known as "planets," and all of us have heard about or seen Venus, Jupiter, Mars, or Saturn. In fact, there are quite a number of planets, big and little, and these vary in distances from millions to between two and three billions of miles. These planets shine with the light from our Sun, reflecting that light to us. We see them with our eyes or our eyes assisted by a telescope. We are able, therefore, to see billions of miles.

But, still more wonderful, we can see trillions of miles! According to astronomical science today, all of the suns of night are trillions of miles distant.

Indeed, so far off are they that astronomers usually speak of their remoteness in terms of "light-years,"—that is, the time it takes the light from these stars to reach us. In the case of the nearest known sun of night, this is four and one-third light-years.



The distance around the earth is about twenty-five thousand miles. Since the diameter of the earth is approximately one third of the circumference, astronomers, have been able to compute the distance to the Sun. Using that as a basis, they have calculated the distance to the other suns

The Mechanical Owl of the French Arm

A night-roaming airplane with rockets and searchlights to throw light on a Zeppelin's intentions

NIGHT flying has become a military necessity for reconnoitering and bombing as well as for attacking Zeppelins, which always bomb at night. Extraordinary demands are made on the skill of the pilot. A landing at night can be safely made only if the ground is illuminated or guiding beacons are employed. Were it not for the fact that the average night sky is not pitch black and is even slightly luminous, night flying would be even more dangerous than it is. Yet on those nights when overhanging clouds cut off even this faint luminosity, when everything is wrapped in inky blackness, it may be necessary to send an aviator aloft.

Recently the French had to convert the night plane into something like an owl, so that it can fly even on pitch dark nights. Like an owl, the machine, with which they have experimented, is very slow—an old-fashioned Farman "pusher" which would fall a ready prey to a fast enemy machine in daylight. But how does it find its way? By illuminating devices, of course. They may not be heavy because the machine cannot carry much additional weight. There are three luminous eyes in the form of searchlights mounted on the lower plane, as our photograph shows. As the owl swoops down on its prey, they flare up and enable the pilot to single o the target.

But sometimes the searchlights are i adequate. Greater efficiency is often d manded. And so we find that the m chine carries as well eight illuminati rockets, four to the side. They a mounted nearly horizontally between t wings and are no doubt discharged b electrical devices. The mere pushing an electric button is enough. Rushir out with a hiss, far out in front of th machine, each emits a dazzling flar which, suspended from a small parachut lights up a large area through which machine may pass. The flare lasts lon enough to enable the aviator to make a emergency landing if need be; for th lights of an airdrome are difficult t pick up.

By means of rockets, it has becom possible to sight a Zeppelin in an inky sky At night a Zeppelin is detected only by it propellers. It is practically invisible But, if the rockets be aimed in the direction of the betraying noise, by swinging the entire machine, there seems no reason why it should not throw real light on the Zeppelin's intentions.

These owl machines seem especially intended to mother small *avions de chasse,* which, because of their speed, climbing and maneuvering ability, can attack an illuminated Zeppelin.

© Int. Film Serv.

The rockets on this night machine are electrically discharged. They are for use when darkness confuses the aviator. Each rocket carries a flare at the end of a parachut

Who Would Think That the Little Mole Is a Gormandizer?

THE little mole has recently been recommended for membership in the society of big eaters. It is so very voracious, even in captivity, that it will sometimes eat more than its own weight of earthworms in twenty-four hours. One little glutton, weighing four ounces, devoured seven and one-half pounds of worms in one month. When the diet changed to raw beef, mutton, chicken heads and rabbit liver, its appetite was unchanged. Cheese, when mixed with either worms or beef, was the most toothsome bit of all.

Wait for the Fire Net—It Will Come Up to Meet You

A PORTABLE fire net which may be raised to meet those who fall, or find it necessary to jump from windows of burning buildings to save their lives, has been invented by Allen Warwick Smith, of New York. It is the inventor's object to bring the net nearer, or adjacent to the upper stories of buildings, to instil confidence in those who fear to jump, and also to prevent the person falling from gaining sufficiently great momentum to crash through the net.

In a fire, the portable net is rolled up close to the imperiled building so that the first platform is within easy jumping distance

Should it be necessary to keep the net some distance from the burning structure to avoid contact with flames issuing from immediately below, an additional net or platform is fastened to the window upon which those who desire to reach the main net may walk or roll. The upright supports are mounted on combination castors, so that the net may be rolled along the sidewalk or held stationary. All parts of the net are detachable and can be folded for transportation.

Cincinnati's effective warning to her populace: Be loyal or to the stock you will go

Reviving Ye Olden Tyme Stock in Cincinnati

A COMMITTEE of patriotic citizens of Cincinnati, who desired to impress upon the minds of certain people that the old time method of punishment would be meted out to those found guilty of unpatriotic utterances or of conduct unbecoming an American citizen, placed this straight backed seat and stock in Government Square. A few hours' imprisonment in the stock would be ample punishment for any offender, said those who were responsible for the demonstration.

Plainly inscribed on the stock are the words, "This Is For Traitors." The young man in the picture consented to pose for the photograph to illustrate how uncomfortable a real offender would appear in the stock. He is innocent of any wrongdoing himself. His legs are held securely in the wooden block, which is fastened to the framework with lock and key. No one has yet occupied the stock—and we hope it will remain untenanted.

Learning to Fly on Jets of Air

Do you remember the ball that dances in a jet of water in every shooting gallery? Here's an instruction machine built on that principle

IT'S expensive to train airmen. On the average, students break from one to two airplanes each before they have mastered the rudiments of the art and know how to fly. Private aviation schools charge heavily for breakage. Uncle Sam has to pay the bill himself. In any event much money is wasted. The training of 5,000 aviators means the destruction of 6,000 machines at the very least, and each machine costs about $7,000.

Now airmen may learn at least the fundamentals of flying on a machine like that here shown. It's on the ground, for which reason students can't break much. Yet they go through practically all the motions of controlling a machine in a treacherous, gusty wind.

The machine in the foreground is a fan. Through the connecting tube it blows a strong current of air to the conical pedestal of the make-believe wings. Through the conical device the air is delivered at four points a[illegible] the underside of the cross-shaped above. It is the fledgling aviator' to sit up on top of this cross-sh structure and to keep it balanced ag those jets. The pupil-operator main his balance with regular airplane con You know that a ball held up by of air or water dances constantly, though it stays in the jet. Imagine what a task a man has when the st ture that he is to balance is supporte four different corners only by flicke

This air lady is learning all about flying—without leaving the ground. It is her job to keep the machine balanced against four air currents coming from the pipes beneath

jets! His controls open or close the "boxes" above the jets just enough to keep him balanced. Foot levers manipulate a "vertical rudder" as in an airplane. This vertical rudder is visible just beneath the nearest box. Tilting it to one side or another enables the airman to keep his machine in the path of the jets.

Attempts at devising practical ground training machines for flyers have been made before. Long ago the French constructed a machine in which the candidate was placed high up on a pivot. It was the candidate's task to balance the machine by manipulating a control pulled on sliding weights. These moved out laterally in four directions along arms somewhat smaller than those illustrated. This machine was interesting in principle, but it could not simulate actual flying conditions accurately, since weights will not move with the same uncertainty as air currents. The new machine probably will be more satisfactory.

The Largest Check in the World Was Easy to Cash

THE biggest check in the world is not the one made out recently by J. P. Morgan for some hundred millions of dollars, but one made out for a mere five hundred and seventy-five dollars on paper twenty-two inches long and ten inches wide. The check was drawn by the Otterbein Men's Bible Class of the Grace United Brethren Church of Carlisle, Pa., in favor of the new church building fund. The check is printed in gold and contains a photograph, in the left hand corner, of the pastor of the church.

This, the largest check (in inches) ever made out, was given toward a church building fund. It measures twenty-two inches in length


Excess water makes concrete easy to handle, but impairs its strength. So after the road is laid, this roller is used to press the concrete "dry"

Squeezing the Excess Water Out of Newly Laid Concrete Roads

WERE it not for Captain J. J. Gaillard, City Engineer of Macon, Georgia, excess water would still be regarded as an unavoidable evil in building concrete roads. He has originated a finishing treatment for the concrete, which squeezes out a large amount of the water after the road has been laid.

After the concrete has been roughly finished, a wide, heavy roller is drawn across the road. The weight of this roller removes the uneven spots in the road, and at the same time presses out the water that has lodged in the minute spaces in the sand and gravel of the concrete.

When this operation is repeated many times, there is little water left. Especially is this so in the top surfaces of the road bed. The result is that where the wear on the road is the greatest, the concrete will set rigid.

Some New Devices for Comfort and Convenience. These Appliances Help the Wide Awake Office Man to Attain Efficiency

The desk at the right outwardly resembles the ordinary office desk. But it has handy card and letter files fitted into every drawer

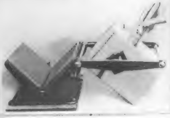
Above: A metal device for rapidly creasing papers. It fits on the thumb

For convenience in reference, these expanding wallets have openings which hold cards for listing contents

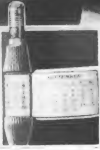
A pe[illegible] inven[illegible] Frank[illegible] which [illegible] pencils

A fireproof steel cabinet inclosing a mechanical account record. It shows the net profits from every employee and gives an inventory of your business

A [illegible] m i[illegible] w h[illegible] simi[illegible] card[illegible] in s[illegible] f o r[illegible] easy[illegible] An [illegible] al s[illegible] blar[illegible] in tl[illegible]



A small press designed for the office. It tabulates paper for scratch pads



A lead pencil having calendar attached

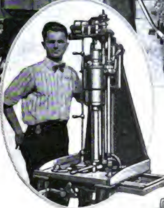
Clever Labor Saving and Safety Devices for the Mechanic Who Is Up-to-the-Minute in His Craft

At left is shown a small saw set with a grip like a pistol

At right: A gage for finding the lead of a thread

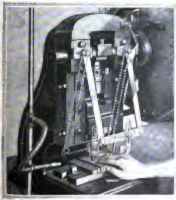
A self-propelled, power-driven elevator which picks up loose material and loads it on a wagon

A master truck is used in a munition factory. Lifting or lowering the handle loads and unloads the heavy racks



A special machine for grinding engine cylinders which need to fit snugly

A press which is necessary to adjust and remove arbors from fine work turned in a lathe.



© Brown and Dawson

A safety guard on a die press to prevent injury to an operator's hand

Small disk grinder for pattern makers, cabinet makers and others doing **fine work in fitting joints**

Hoisting the concrete boat which weighs more than a ton. It is giving as good service as a wooden boat

The Great Lakes Training Station Gets Its First Concrete Boat

FOR many years concrete has been successfully used for barges and pontoons, but it is only recently that it has been used for other types of vessels. Norway has completed a concrete boat of three thousand tons, and a much larger boat is now being constructed in San Francisco. Montreal and Seattle are centers of concrete shipbuilding and New England shipbuilders are watching the experiment with interest.

The accompanying illustration shows a concrete boat built by Walter N. Dowsey, a lumberjack of Iron River, Michigan. He presented it to the U. S. Na Reserve Force Auxiliary, Chicago, which is a part of Great Lakes Naval Train Station. The boat has arou great interest, principally cause it is the work of a m with practically no knowlec of shipbuilding and with ve little knowledge of concrete.

The boat is eighteen feet, inches long, with a beam of fc feet, six inches. It is propell by a six-horsepower engine a despite the fact that the h was not smoothed off it is ca able of making a speed of t miles an hour. Concrete, co sisting of one part Portlar cement to one and a half par of sand, was applied with trowel on a carefully designe framework of steel ribs, and w allowed to harden under cove The boat weighs two thousan three hundred pounds, twice much as a wooden boat.

Looking Through a Steel Axle with a Periscope

THE periscope, so efficient in trenc and submarine warfare, now ha a pacific application. It promises t avert many accidents resulting fron defective locomotive axles.

The axle is bored longitudinally, th size of the bore being ample to permit insertion of the periscope, which is about forty inches long and one and one-half inches in diameter. At one end is a magnifying mirror upon which a light is thrown from the handle. Looking through the periscope, inspectors obtain a clear view of every part of the axle and are enabled to detect the flaws in the steel.

The axle periscope enables the railroad inspector to examine every part of the locomotive axle and to locate flaws instantly

Like a Wasp on the Wing

Is the New Albatross Destroyer in which the Germans have embodied all that the war has taught about fast fighting airplanes

By Carl Dienstbach

THE war will be won by that power which launches into the air the greatest number of the fastest fighting airplanes. This seems to have been realized from the day when it dawned on the general staffs of Europe that artillery must be aimed by a man several thousand feet in the air, that the enemy must be prevented from similarly directing his own fire, and that as a result, fighting machines must be resorted to in order to gain supremacy in the air. As a result, the warring nations have been trying to outstrip one another in producing the fastest and most formidable fighters. British, French, Germans have all commanded the air at different times, and the times usually coincided with the appearance of faster and more improved machines.

Upside Down in Mid-Air

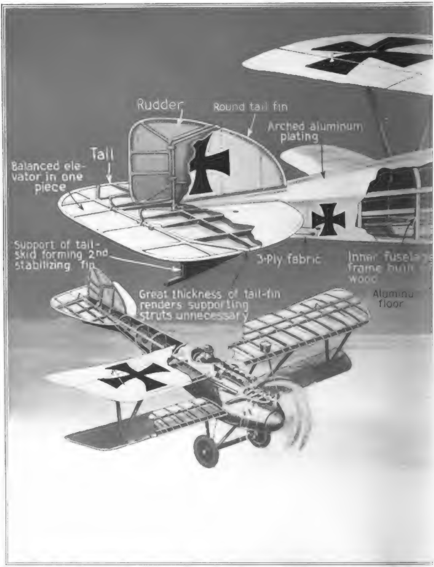
We used to marvel at the men who looped-the-loop in flying machines or slid down sideways or tail first, wondering what was the good of it all. The wildest acrobatic feats performed at flying-machine meetings before the war are now part and parcel of every fighter's tactical equipment. He must put himself in a favorable position and if necessary must loop-the-loop to do so.

Whenever the newest type of hostile machine is captured, it is examined with microscopic minuteness. The curve of its wings, the spacing of its struts, the shape of its fins and tail, the material of which it is made, the proportioning of its different parts—everything is measured, tested and noted. It is not only studied; it is copied. This is no time for riding pet hobbies. The best that the enemy has must be not only imitated, but bettered.

It seems to be conceded in the British and French despatches that the new German Albatross destroyer known as "type D-III" is for the time being the fastest and most formidable fighting airplane on the Western front. In this remarkable piece of mechanism we see embodied in steel, wood and linen, all the lessons so bloodily driven home by two years of fighting in the air. The new Albatross is an amalgamation of the best features to be found in the original small Albatross and the latest fast French Nieuport.

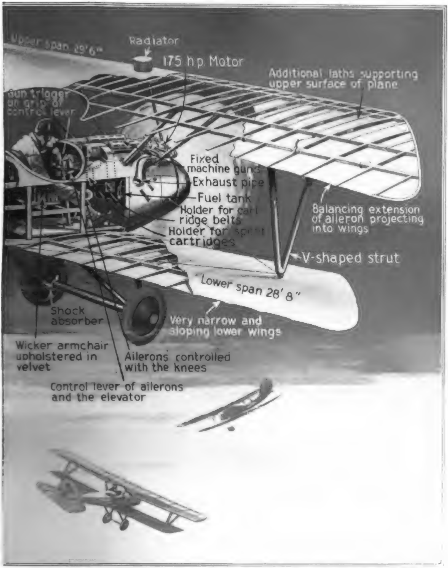
Above all things, a fighting machine must be fast. A speed of one hundred and thirty miles an hour is about the minimum now. In addition to speed, the machine must have the maneuvering power of a wasp; it must be able to dart up and down and in and out with the rapidity of an insect.

In the French Nieuport machine these two essential qualities of speed and maneuvering ability were more highly developed than in any other. The Nieuport is a biplane in which the lower wing is but half as wide as the upper. We look at the Albatross. Sure enough, its lower wing is one-half the width of the upper. In the fast Nieuport, the wings are "staggered"—that is, the lower wing lies not directly below the upper, but slightly to the rear, so that the front edge of the lower wing is just beneath the rear edge of the upper one. Why is this done? Because the struts that tie the two wings together can be shortened. Shortened struts, in turn, mean less wind resistance. Look at the detail drawing of the Albatross that accompanies this article. You see at once that the Albatross, too, has "staggered" wings and short struts.



In their new Alabatross destroyer, which is probably the fastest fighting machine on the machines and have added improvements of their own. A stationary engine of 175 horse-

Why is the lower wing narrower than the upper? There is a kind of interference between upper and lower wings. The air is "caught," as it were, between the superposed surfaces. If the lower wing is narrowed this interference is largely prevented. But there are structural reasons, too, for narrowing the width of the lower plane. Note in the drawing that the struts are triangular in form and that the



western front, the Germans have copied the best features of the French and British fighting power drives the Albatross through the air at the tremendous speed of over 130 miles an hour

rear member of a triangle lies directly behind the front member. Isn't it obvious that the triangular strut thus formed is strong and light and that it will offer less resistance to the wind than if a rectangle with diagonal wire bracing were adopted? Note, too, that the staggered wing construction with the narrow lower plane makes it possible to fasten each triangular strut directly to the lower main beam.

This adds to the strength of the entire biplane.

But the Germans have improved upon the Nieuport in this: They have spread the central struts which hold the upper wing to the fuselage or body, far apart. Hence the two wings are tied together by only two sets of struts—the triangular ones previously described and the central ones. Why was this done? Simply to avoid the use of wires. In the older machines, by which I mean machines that flew in the early weeks of the war, there were a far greater number of wires than would now be considered permissible. Wire bracing extended in all directions. Now, a piano wire which vibrates a distance of half an inch to either side of its normal position offers as much resistance as a rod one inch in diameter. A wire may seem thin, but when it vibrates it is the equivalent of a thick rod. It offers much resistance as a result. And so we find the airplane designers of the world trying to get rid of wires. The builders of the Albatross have gone far in this direction.

From the British, the Germans copied the rounded outline of the tail fins. The tail surfaces of a flying machine have much the same effect as the feathers of an arrow. They steady the machine. The perfect target arrow has rounded feathers. This explains the British tail formation of the German Albatross.

More than any other fighting machine thus far designed the Albatross is shorn of projections. Indeed, the craft approaches a bird in cleanness of line. The water tank, for instance, is no longer found near the engine; it is built into the upper wing. The radiators, through which the cooling water circulates, lie flat against the fuselage or body.

Steadying fins and rudders and ailerons (the hinged surfaces at the rear corners of the upper wing, serving to balance the machine from side to side) must be strong and stiff and yet free from external support. But their wind resistance must be low. The Germans met the situation by giving the fins and rudders a streamline form, which means a shape that parts the air most easily. The steadying effect of a fin depends in part on its area. Additional area was gained very cheaply by filling out the space between the fuselage or body and the tail-skid.

The fuselage or body in which the singl fighter sits is noticeably large. But mar the lines. This smooth, correctly de signed bulk, large as it is, parts th air with the lowest possible resistance Note how the fuselage and the wing are tied together so as to get ri of struts and wires. The idea is not new but it has been so ingeniously carried ou that it deserves mention here.

The exhaust from the engine is care fully collected and conducted downwar and rearward. Whiffs of exhaust ga should not be added to the tribulation the pilot already has to bear.

It takes a certain amount of muscula effort to swing a rudder quickly. Clearly, the fighter who can swing his rudder most quickly has the greatest maneuvering ability. The muscular effort involved, must not retard a man from making the right turn at the right moment. Hence we find that in the Albatross all the controlled surfaces are balanced, which means that triangular extensions are provided beyond their pivots. You will find this clearly brought out in the tail of the Albatross as it is shown in the accompanying drawing.

Since the entire machine must be swung around in order to aim a gun, it is obvious that as many as twelve guns could be mounted if there were place for them. Indeed, on the Nieuport as many as five have been carried—three on the upper wing and two firing through the propeller. No doubt a similar practice is followed by the Germans. In our drawing we have shown only two machine guns firing through the propeller.

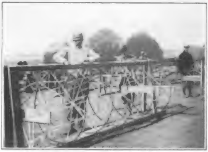
How astonishing it is to find the inventions of fairy-tale writers brought to realization. For years we have been entertaining our children with one of the most beautiful fairy-tales of Hans Christian Anderson—a tale in which a wicked prince rashly essays to fight God himself with ships flying through the air and mounting guns that rain thousands of bullets in response to the mere pressing of a button. Look at the Albatross and you will see the magical buttons attached to the control-lever. Who knows but flying machine designers may find other improvements suggested in what we have been pleased to consider the poetic vaporings of romancers!

You Aren't Spilled Out With This Life-Boat Launching Device

HERE is one of those "do-it-with-a-twist-of-the-wrist" inventions, which, though not at all complicated, seems capable of solving an exceedingly troublesome problem. To launch a life-boat right side up, is the special mission of the invention. Dr. Charles Hunt of New York conceived it. Having crossed the ocean many times, he naturally became interested in life-boat problems. And the machine he produced has been proven by Government tests to be one of the most successful thus far devised.

The trouble with life-boat launching devices at present, is that it is difficult to unhook the tackle blocks, once the boat reaches the water, especially in a heavy sea. Dr. Hunt's contrivance consists of the mechanism which he is shown holding in his hand, one of which is fastened at each end of a life-boat. Ropes run from these to a lever centrally located. If a man in control of the boat pulls this lever even when the boat is but a few feet above the water, the tackle blocks are quickly and safely released, and the craft launches itself right side up, even in a rough sea.

Pulling a lever in the center of the craft releases this life-boat upon reaching water



This cylindrical barricade can be rolled over but it cannot easily be surmounted

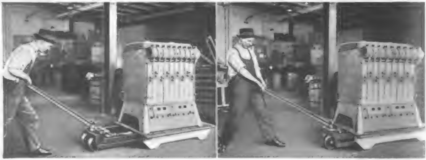
A New Barbed-Wire Fence to Hold the Germans in Check

THE latest barbed-wire fence which the French have designed to check the advance of the enemy, employs a series of immense barrel hoops, on which barbed wire is strung. The hoops are securely fastened to a wooden fence-form—six hoops to a section of fence—so that it is possible for each entanglement section to roll over and over like a string of lopsided pushballs joined together to form a solid unit.

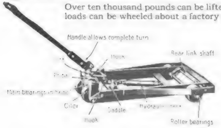
When the sections are to be set up, they are dragged out under cover of darkness and so arranged that the natural land formations of the vicinity conceals them from advancing troops.

Walls Are Suspended from the Roof of This Building

ONE of the queerest structures in the world is an electric-station building at Cristobal, in the Panama Canal Zone. The roof is supported by powerful central columns and the side walls bear no weight whatsoever but are suspended from the eaves by means of cantilever beams. On one side of the building, the wall is made fast to the foundation with anchor bolts. This unique construction was adopted to prevent the building from settling at a dangerous angle, should an earthquake tremor shift the foundation.



Over ten thousand pounds can be lifted by this inexpensive little truck. With it heavy loads can be wheeled about a factory more easily than with the costly traveling crane



What One Lifting Truck Will Do in Factory Hauling

A TRUCK which will lift all but the largest castings upon its back, and then carry its load away with but a single man to operate it, has been introduced into the factories. Its usefulness is almost unlimited.

Medium-sized machines in the foundry and shop can now be carried about, not with a ten thousand dollar traveling crane, but with a little eighty-five dollar hand truck. Small castings, such as the little heater shown in the photograph, need not be moved with rollers and crowbars, which require several workmen and precious time.

Each truck is provided with a hundred separate platforms. These are distributed about the shop. When a product has gone through o operation, it is loaded directly upon t platform, on which it is carried from o place to another.

The truck sides are parallelogram When they are in their collapsed positio the truck is readily slid under the load platforms. Then using the truck hand as a lever, the workman attaches a hoc upon the stub end of the handle ar raises up the sides until they form a oblong. The sides are automaticall locked in this position, and the raised loa may be wheeled wherever desired. B pressing a pedal on the head of the ma chine, the sides are tripped. The loa is gently lowered by a hydraulic check

The Soap-Box Orators of Los Angele Have Concrete Pulpits

THE authoritie of Los Ange les, California, hav endeavored t beautify their cit and to keep th streets free from congestion. The most novel device for the purpose is a cement pulpit. These ornamental pulpits have been placed at specified locations for the free use of street preachers and stump speakers in general.

The stump speaker's pulpit before which the crowds may gather without blocking traffic or breaking any restrictive city ordinance

Escaping from a Straight Jacket in Mid-Air

HARRY HOUDINI, self-styled "handcuff king," recently escaped from a straight jacket, while suspended by the heels, head downward, in mid-air, over Broadway, in New York City. How did he do it?

In order to escape from a straight jacket, it is necessary, first of all, to insure as large a play as possible for the arms. Hence the arms must be pressed out as forcibly as possible, while the straps attached to the hands are being pulled and buckled behind the back. Suppose that the performer is on solid ground. He first places the elbow of the arm passing under the other arm upon the floor, or upon some solid substance, and, by sheer strength, forces it over to one side—an upward pull being exerted at the same time. The position is then changed and the pressure applied to the opposite elbow—an upward pull again being exercised. The arm is thrust back across the front of the body, and upward toward the neck. This alternate movement is carried on until enough play is obtained to wrench the arms from side to side and to work them nearer the neck. Thus "slack" is obtained to pass the strap connecting the wrists, over the head. The buckle, by which the hands are strapped together is brought to the front, and unfastened by the teeth. The sleeves are then pulled down. Next, placing his hands behind his head, the performer can undo the buckles. He can then remove the straight jacket. In mid-air the method is the same, but more difficult. There is no leverage to brace against. Therefore, his escape is nothing short of marvelous.

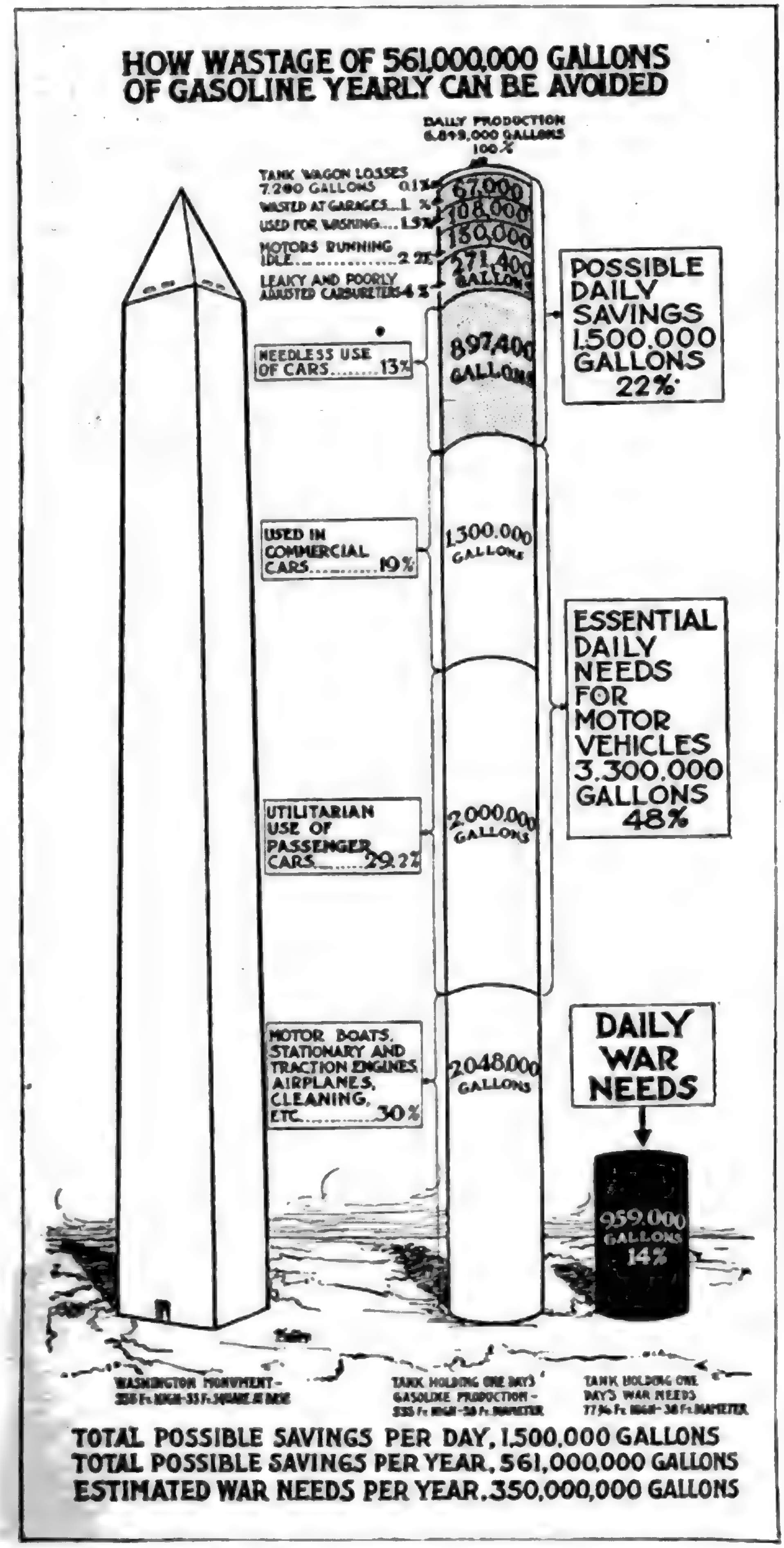
To save a newly paved street from ruin, Cleveland, Ohio, posts a timely warning

Houdini, hanging over space, ready to make his spectacular escape from a straight jacket

Warning the Public to Leave a Newly Paved Street Alone

TO prevent the tearing up of newly-paved streets, Cleveland, Ohio, has set an example which is worthy of serious consideration. Before a street is ready to receive its new covering, warnings are posted, calling the attention of the public to the fact that all underground pipes should be put in at once, because no permits for cutting the pavement will be allowed for five years. The signs have proved very effective in preventing excavating work in newly-paved streets. The people have learned that if they will use a little forethought, the streets of their city need not so constantly be broken up.

Help Do Your Bit By Saving Gasoline



Poster prepared by the National Automobile Chamber of Commerce showing how to avoid wasting gasoline

ONE way to win this war is to insure a sufficient supply of fuel by eliminating gasoline waste. Look at the accompanying illustration and you will see that there is a daily waste of one million, five hundred thousand gallons out of a total daily production of nearly seven million gallons. This is needlessly large.

For war needs of the army, navy and aviation branches, nine hundred and fifty-nine thousand gallons of gasoline must be had each day, which is less than two-thirds of what may be considered as wasted at present. Were owners of automobiles to stop needless mileage, nearly nine hundred thousand gallons of gasoline could be saved each day.

The very highest grade of gasoline is necessary for the thousands of airplanes now building, most of which will use the new Liberty motor, now being made in great numbers in the automobile factories. Great quantities of gasoline will also be required to operate the thousands of army motor trucks to be used by our growing force in France.

Although the production of crude oil in this country has been increasing at a tremendous rate for a number of years, during the past twelve months it has not kept pace with the growing demand.

What Are Shooting Stars? Where Do They Come From?

OUR knowledge of shooting stars extends into the oldest history of humanity, back into prehistoric times. Yet to-day no one knows exactly what a shooting star is, or from where it comes. An hypothesis proposed in 1875 and generally accepted to-day, is that meteorites are fragments broken from small planetary masses by volcanic explosions, brought about by a sudden expansion of gases, steam and probably hydrogen. The broken bits, after their separation, are believed to arrange themselves in swarms which cross the orbit of the earth in accordance with a definite law. Shooting stars, then, undoubtedly come from within our solar system and are broken bits of a world body destroyed by volcanic events. Many meteorites have been found in Arizona.

Formidable Machine Gun for Young America's Trenches

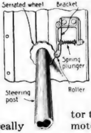
THE most popular toys are those with which real fighting can be done. Cannons must really roar; guns must really crackle as they fire the imaginary bullets, and machine guns must be mounted on wheels, if Young America is to be expected to approve them.

Master M. Churchill Haenke, the man behind the gun in the accompany illustration, is the proud possessor of a father who can make armored cars that look just like the real thing to the critical juvenile eye. The car in the picture is all the better looking for being homemade. It is equipped with a miniature mortar and a machine gun which makes a racket like the crackle of gunfire, when a crank is turned. Master Haenke supplies his own motive power.

The homemade pushmobile converted into a sputtering machine gun. It gives the impression of being the real thing

The stabilizer prevents any serious disarrangement of the steering wheel by keeping it firmly fixed in a given position

A Stabilizer for the Steering Wheel Makes Driving Easier



MUCH of the strain of driving an automobile or motor truck would be eliminated if every motor vehicle were fitted with a new steering wheel stabilizer. The device is the invention of O. Wm. G. Holmgren of New York city. It is made to hold the steering wheel in the position desired by the driver, without obliging him to keep one hand continually on the wheel. A small wheel with a serrated edge is placed on the steering column beneath the floor-boards, and a spring-tension plunger with a roller-end, is fastened to a bracket which bears against the wheel serrations, one at a time.

When the steering wheel is turned, the friction caused by the spring tension between the roller and the wheel must be overcome before the roller passes on.

Change Yourself into a Fish

Here's an invention that supplies everything a man lacks to swim under water

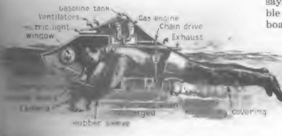
A one-man marine suit which can be used for salvaging, life saving and for wartime duty

IF you know the story of the submarine you will at once see the similiarity between the invention illustrated and the first submarine, built during the reign of King James I. That old U-boat was constructed of wood and was designed to be propelled by oars extending out through holes, the water being prevented from coming in by goat skins tied about the oars and nailed to the sides, to make a watertight joint. In the one-man submersible described here, human arms take the place of oars, rubber and steel supplant goatskin and the propelling power consists of two separate units, one for surface and the other for underwater running, such as we have in our modern submarines.

In its present de-

portion has its sides fitted with glass windows and the bottom portion has a telescoping window, so that the operator can guide the vessel where he desires, lying in a longitudinal position with his legs projecting out behind like the tail of a fish. Directly above the shoulders of the operator is a gasoline engine connected with a shaft which revolves the propeller. A compressed air motor with a storage tank takes up the space beneath the operator's body and is to be used when the boat is submerged. Collapsible tanks under his arms correspond with the ballast tanks of a submarine and water is taken in or expelled according to whether it is desired to rise or sink. Levers to operate both engines are within convenient reach. To work them, the operator must remove one hand from its rubber sleeve.

To supply air for the interior of the shell when the boat is running on the surface, floating-ball ventilators are provided which automatically close when water strikes them. The body portion of the apparatus is fastened by straps to the shoulders of the operator, so that he can walk upright with it, or swim in any direction—something no man can do with an ordinary diver's equipment. The boat in its present form weighs about one hundred and twenty pounds, but for navigating work at a depth of one hundred feet or more, it would have to be very much sturdier and heavier than it now is. The inventor says it is possible to make his boat the fastest underwater machine in the world, capable of a speed of forty miles an hour with a radius of action of twenty miles.



The propelling power consists of two separate units, one for surface and the other for underwater swimming

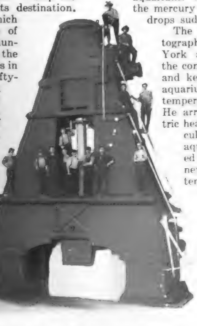
The Sugar Shortage Is a Blessing in Disguise

FROM the standpoint of hygiene and economy, changes in diet represent a positive gain. For instance, take sugar—a food which yields more calories per unit of cost than any other food, but which, on the other hand, gives us nothing but energy. It contains no protein and no mineral value, elements which are essential. So the present sugar shortage is a blessing in disguise, for we are obliged to substitute in its place vegetables and fruits, which are real body-building foods. Had we made this simple substitution many years ago we might have been a sturdier race to-day.

A small electric heater arranged in the water circulation system of an aquarium

A Giant Forging Hammer Which Weighs Six Hundred Tons

A STEAM forging hammer which weighs six hundred tons and delivers a blow of eight thousand tons was recently installed in an ordnance plant. It required fourteen railroad cars to ship the hammer in sections to its destination. The main steam pipe, which admits a steam pressure of from one hundred to one hundred and fifty pounds into the giant cylinder, is ten inches in diameter. The ram is fifty-one inches wide, sixty-six inches front to back and seventy-two inches high. The approximate weight of the die alone was ten tons. The whole superstructure is mounted on four massive pedestals. The main cylinder is lined with cast-iron bushing of special mixture. The cylinder proper is mounted between the two main frames and it is securely bolted with body-round bolts, the frames *being shrunk together* with four large rods.



This huge steel forging hammer is the largest of its kind ever built in the United States

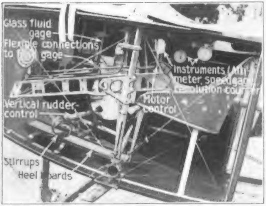
Keeping the Fish in the Aquarium Comfortable in Winter

WHILE it is true that there is no heat provided for the fish in the rivers and lakes during the winter, it does not follow that the fish in the small glass aquariums do not suffer when the mercury in the thermometer drops suddenly.

The accompanying photograph shows how a New York artist provided for the comfort of his gold fish and kept the water in his aquarium at just the proper temperature all winter long. He arranged a small electric heater in the water circulation system of the aquarium and regulated it so that the water never varied from the temperature which has proved most agreeable to the fish. It was interesting to watch the fish swim madly about on one occasion when the heater did not keep the water at just the correct temperature. They noticed even the slight change almost immediately.

Models for American Airplanes

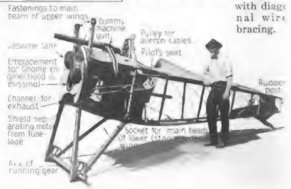
Our manufacturers are turning to Europe to get the latest airplane designs



structural details and propo tions that airplanes of to-d are superior to the old m chines, not to mention t question of safety. The loc tion of the sockets for t mainbeams of each wing di closes, for instance, that if tl lower plane is made muc smaller, it should be mounte far enough behind the upp plane so that the struts can b made to converge downwar and be fastened only to th frontbeam of the lower win This gives a very strong tr angular construction, of sma air resistance that dispense with diago nal wire bracing.

Although an American invention, the airplane has received its greatest development at the hands of Europeans. The aviator no longer has to guess. There are instruments under his eyes to tell him everything of importance

At the right is a model which our manufacturers are following closely. Every part has been the result of dangerous experimentation and practical usefulness. Note the position of the dummy machine gun, on top



THE machine pictured, is the last word in fighting airplanes that derive the utmost efficiency from the extreme speed and the quick maneuvering and climbing that can be attained by a small, one-man machine. Cutting down the size of the lower plane, makes it superior to other small biplanes. This type has recently been imitated by the Germans in their latest small Albatross fighter, as we point out in another article published elsewhere in this issue.

Parts of the latest Nieuport have been taken to serve as a model for the details of American-built "chasers." It is in

Condemned Army Boots Make Serviceable Roads

WASTE boot leather has been used for making roads, in England. Combining it with slag, granite, limestone, asphalt and bitumen, a material was obtained which possessed the hardness and rigidity of the ordinary tar macadam road and at the same time reduced dust and was more resilient than the usual road. Although it was sufficiently hard to bear heavy traffic, it yielded without cracking on the surface. It was patented in 1910, under the name of "broughite."

Bubbles in the Blood Kill Many a Poor Soldier

SOLDIERS are found dead on the battlefield, with no mark of an injury. Some are lying with arms outstretched as in running; others are grasping their guns as though about to fire—all are in exactly the positions in which they were at the moment of death.

These mysterious deaths do not occur as a result of nervous shock; else the bodies would be relaxed and natural. They are victims of "the bends" or "caisson disease" caused by sudden release from great air-pressure.

When a workman emerges from a high-pressure air chamber, his blood fills with small bubbles, like those of champagne when first uncorked. If the bubbles are large enough to choke the circulation, the man dies. On the battlefield, such occurrences are the result of intense explosion-waves. The blood holds in solution a considerable amount of air and carbon dioxide, the quantities being greater when the pressure is high.

Upon lowering the pressure, the gases separate out as bubbles. In the case of soda water, the bubbles can escape, but in a man they are caught in the capillaries. All muscular action is arrested with lightning-like rapidity, thus preserving the attitude held by the victim before the fatal attack.

A small steel mirror for the trenches. With it a soldier can shave perfectly

No Trouble if This Mirror Drops. It Is of Indestructible Steel

A THREE by four inch mirror, which is intended especially for use in the trenches, is made of a special metal which contains a high percentage of nickel. It will neither rust not corrode.

The surface of the metal is highly polished and reflects almost as well as glass. It is protected by a soft lined case into which it fits.

It is usually carried in the upper left hand coat pocket, where it does excellent service as a shield, being sufficiently strong to divert glancing bullets.

Chewing-Tobacco to Clear Windshields! Would You Believe It?

WHILE inventors are trying to devise something that will effectually prevent the fogging of automobile windshields in rainy weather, along comes Theodore Petersen, a druggist in Grand Rapids, Michigan, with a plug of ordinary chewing tobacco and solves the whole problem!

Not only does the tobacco prevent the windshield from fogging, he says, but it enables the rain water to run off the glass without collecting in drops. After each application it is only necessary to rub off the glass with a cloth to remove all marks of the tobacco

Just rub the tobacco off the windshield with a clean cloth

How One Builder Keeps His Men Employed During the Winter Months

NEARLY all of the concrete foundations for a new lumber shed and a new cement and lime storage shed in Cumberland, Wisconsin, were laid during zero weather. The water and aggregates for mixing were heated, and shavings were packed in a compartment outside the forms to prevent the freshly placed cement from freezing. The cement was left in the forms until spring. When examined it was found to be perfectly good and solid.

The materials used in making the cement during zero weather had first to be heated

The Newest Type of Cooker Was Invented Two Hundred Years Ago

OUT in Denver, Col., a new type of fireless cooker has been put on the market, by J. E. Crook, which is frankly an improvement on an idea two hundred years old. It is called a pressure cooker and is so small that it may be packed away in your trunk when you go away to the country, or in the automobile when you contemplate a long trip.

It is simply a steam-tight cooker, complete in itself, without the usual box-container. It is made of aluminum, so that it is light in weight and convenient handle, as well as strong enough to re: the interior 200-pound steam pressi upon which t cooking d pends. Saf devices are p: vided • on t cover to ta care of the si plus stea The safe valve is ma separable, that it may easily clean and kept condition. T steam gage calibrated thirty poun on a dial th: can easily t read. Whe the food h: been in th cooker lon enough, a thumb-screw of the petcoc is turned to release the steam so th: cooking will stop.

The cooker in operation. Note the steam gage and the petcock

A Novel Operation to Cure Hysterical Deafness in Soldiers

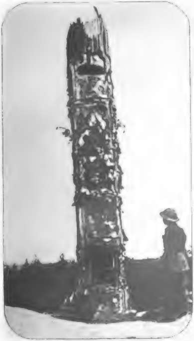
SURGEONS hav recently identifi ed hysterical deafnes in soldiers as deafnes not accompanied b; muteness. They ar curing it by an operation. The patient i: given enough ether tc excite him, then two small cuts are made behind his ear. A hammer is then banged on a sheet of iron, and, if the operation is successful, the patient jumps off the table with his hearing completely restored. Before the operation is made, the patient is encouraged to feel that he will be cured.

How the Germans Burrow in Hollow Trees

AT first glance the post shown in the accompanying illustration looks like an Alaskan totem. But do not let its exterior appearance mislead you. Look carefully at the second story window and peering through it you will see a soldier. He gives the secret away. The post is an observation station constructed within the hollow of a shell-broken tree. After it was captured from the Germans by the Canadians, it was left standing on the spot as a relic.

In reality, the post is a hollow structure camouflaged with foliage and bark. Iron sheeting has been placed around the trunk and over it foliage and bark have been draped to give the tree a life-like appearance. Above the second story window is a slit in the bark which would enable a third man to keep watch. Each aperture in the trunk is covered with wire netting to afford protection to the observers from flying shell splinters. An iron ladder, faintly visible in the photograph, enabled the men to climb up or down as they wished. The fact that a trench lies at the foot of the post, made it possible for the observers to take up their positions without exposing themselves to the vigilant enemy. One well-placed shell could have obliterated the tree.

Resembling an inverted ice-cream cone, the war photographer's helmet affords his head and neck full protection from shell splinters, bombs and rifle bullets



A three-storied German observation post constructed within the hollow of a tree

A New Conical Steel Helmet for the War Photographer

A NEW style in steel helmets has been introduced into the military market to meet the demands of war photographers who are making the pictorial history of the world combat. Resembling, to all appearance, an inverted ice-cream cone, the new helmets completely cover the face, whereas the helmets now in use by the fighters of all the warring countries, merely offer protection to the upper part of the head. With his conical helmet, the photographer can feel sure that his head and eyes will be protected from flying shell splinters and stray bullets. Note that the helmets have carrying handles.

A Little Gasoline Locomotive to Be Used Near Front Lines

IT is so vitally important to bring food and ammunition to the front regularly and quickly that all the armies run whole military trains right up to the trenches. A special locomotive has been designed in America to meet the special needs of the army. It runs on a narrow-gage track two or three feet wide, and hauls a long string of heavily loaded little cars. It is able to turn sharp curves at will. It is propelled by a four-cylinder gasoline engine, mounted inside the hood, just in front of the cab. The exhaust is discharged through the stack. A gasoline exhaust gives little or no smoke, and this assists in keeping the little engine's movements secret. Running in all sorts of difficult places, the locomotive can accomplish a great deal of work, all without revealing itself to the enemy.

This little locomotive can haul several cars heavily loaded with supplies for the boys in the front trenches

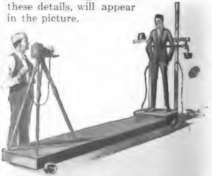
How the gasoline motor is connected with the driving wheels of the locomotive is interesting. Imagine the cab and other superstructure as mounted on the front end of an automobile running backwards, and you have the underlying idea. Where the rear wheels would be on an automobile is a small crank mechanism, visible just under the front "steps" of the locomotive. The four cylinders of the motor lie lengthwise under the hood, just as they would in an automobile. They drive this crank through the medium of clutches, transmission, and power-shafting in the same way as they would the rear axle of an automobile. Power is transferred from the crank-mechanism to the driving wheels through the aid of connecting rods.

"The Measure of a Man," to th Inch—by Photograph

IF you are a busy man and do not li to use up a lot of your valuable ti in being measured for your new suit clothes, you can have your measuremer taken in the twinkling of an eye, photograph.

This is the basic idea of a pate granted to Emery E. Costly, of Walke ville, Maryland. His invention will inc cate not on the measur ments of man but h weight a well. The a paratus co sists of a pla form o which i mounted camera, scale, and height meas using stand ard on th end of a plat form scale.

There i no tiresome standing as there was when the tape measure did its slow work. All the prospective customer has to do is to stand on the platform opposite to the camera. A measuring device behind him will record his height and other measurements and scale his weight. All these details, will appear in the picture.



Be photographed on this platform and the resulting picture will indicate your height, your weight and your measurements

The Modern Soldier's Fighting Equipment

THE equipment of a French infantryman in Napoleon's day consisted of a gun and a knapsack. To-day the soldier carries an array of death-dealing weapons as complete as that of the arsenal itself.

Hand grenades and gun grenades, wire shears and a rifle are carried by the foot soldier in the advance. Pick-axe and shovel he must have when he reaches the trenches. Signal lanterns and sky-rockets must also be carried by the officers to keep headquarters constantly in touch with the progress of the fight.

The periscope and the gas alarm are as necessary as guns. Add to all these the other implements of war and you will understand why physical fitness is the principal consideration in the examination of recruits.

© Underwood and Underwood

The modern soldier carries more than twenty implements of warfare in addition to his gun and blanket. Is it any wonder he has to be strong?

A nature lover had the body of this automobile fashioned out of a hollowed redwood log

A Traveling Home Made From a Giant Redwood

TO construct an automobile body out of a section of a huge redwood tree is a feat recently accomplished by Charles Kellogg of Santa Clara, California. Mr. Kellogg is well known as the first man to imitate birds with his voice.

To accommodate this unique redwood body, an especially-designed chassis was constructed. Then Mr. and Mrs. Kellogg traveled to the Eel river country, where many mammoth redwoods grow. Here they secured from a lumber company a section of one of the large trees. The section chosen was twenty-two feet long, thirty-three feet in circumference and weighed forty tons.

One-half of this piece was cut away, and the selected half was hollowed and the bark was removed. It was then jacked up and the chassis was run beneath it. When dried, this finished product weighed about five thousand pounds. The car has been fitted with windows and doors, and the inside has been equipped with beds, kitchenette, closets, electric lights and all traveling conveniences.

If you have lenses you are not using, emulate the example of this man and enlist them in the army. The officer shown in the picture above is Captain Dawson, who used to make photographs for the "Popular Science Monthly"

Have You a Camera Lens? Enlist It in the Army

THE Signal Corps of the Army needs lenses for cameras to be used by the fleet of observation airplanes now being built. If you have a lens of the required type, do your bit by enlisting it in the service of the Army. Write to the photographic division of the Signal Corps, U. S. A., Mills Building Annex, Washington, D. C., stating what you have on hand and what price you want.

Because the camera lens is the eye of the Army and because German lenses can no longer be bought, a serious situation has arisen. The Bureau of Standards, of the Department of Commerce, is now [illegible] a [illegible] for [illegible] German [illegible] [illegible]

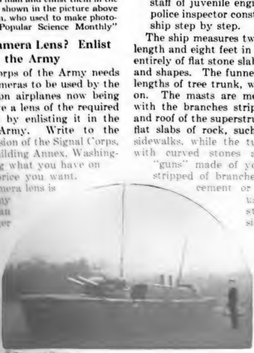
A Battleship Made of Stone—A Landlubber's Feat

ALTHOUGH four months of his vacation went into the building of a stone battleship, John von Wiegand of Brooklyn, N. Y., is proud of the monument which tops a little hill of broken rock, overlooking a stone quarry at Haines Falls, N. Y., in the heart of the Catskill Mountains.

Mr. von Wiegand is a retired police inspector, having passed the age limit of the service. A little over a year ago he spent his vacation in the Catskills and conceived a plan for building a structure out of stone. His choice settled on a battleship.

A number of boys, seeking some form of diversion, soon became interested in Mr. von Wiegand's plan. To each one he gave a time card on which was kept an accurate record of the working hours. So, aided by his staff of juvenile engineers, the former police inspector constructed his battleship step by step.

The ship measures twenty-eight feet in length and eight feet in beam. It is built entirely of flat stone slabs of varying sizes and shapes. The funnels consist of short lengths of tree trunk, with the bark left on. The masts are merely young trees with the branches stripped. The decks and roof of the superstructure are of large flat slabs of rock, such as are used for sidewalks, while the turrets are shaped with curved stones and armed with "guns" made of young tree trunks, stripped of branches and bark. No cement or mortar has been used for holding the stones together, since the weight of these components is sufficient to keep them in place. In the vitals of the battleship has been placed a bottle containing a record of the names of the constructors.



[illegible]

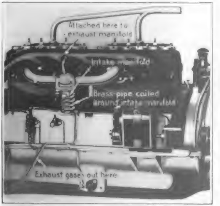
A battleship twenty-eight feet long, which is built of flat slabs of stone. The funnels are short tree trunks

What? A Poisoned Sea in the Atlantic Ocean?

FOR the eighth time since 1844 fish have been killed along the west coast of Florida in an area of poisoned water. Not only the water, but the air has been charged with a suffocating gas, odorless but irritating to the air-passages. The last mortality was reported in October and November of 1916. The Bureau of Fisheries sent experts to the spot but they were obliged to admit, after a careful investigation, that the cause of the strange occurrence is a mystery. One explanation advanced is that earthquake shocks, possibly due to West Indian hurricanes, released poisonous gases from the sea-bottom.

Using the Exhaust Gas to Make the Engine Start Easily in Cold Weather

A SIMPLE device to make your automobile engine start easily in cold weather and to prevent it from sputtering before it gets warmed up, is shown in the accompanying illustration. It consists of a length of one-quarter-inch brass gas pipe screwed into the exhaust manifold and then wound around the intake manifold between the carbureter and the cylinders. The free end of the pipe is then bent downward and backward under the car, so that the small amount of exhaust gas passing out of it will not be disagreeable to the driver or to the passengers. It takes about six feet of pipe to make the device. The heat of the gas in the pipe warms the intake manifold so that the incoming fuel is heated and more completely vaporized. This gives additional power because of the greater heat and effects a considerable saving in gasoline. It also prevents carbon deposits.



The heat of the exhaust gas warms the intake manifold, vaporizing the fuel


An ice formation resembling a giant cauliflower. It remained solid for several weeks

A Giant Cauliflower of Solid Ice. It Was Twenty Feet Tall

DURING some freezing weather in Alberta, Canada, the device which takes care of the overflow from the oil well, shown above, was out of order, and the gas and water squirted high in the air, freezing as it fell. In about a week's time, a beautiful ice formation resembling a giant cauliflower ornamented the side of the building, and reached twenty feet in the air. Its beauty was augmented when the sun shone.

The Motor Truck of Democracy

It's old and yet it's startlingly new. Fifty experts sacrificed their pet hobbies and buried the hatchet of competition to produce it

By Joseph Brinker

THE Motor Truck of Democracy, otherwise known as the standardized war truck of the United States Army, is the greatest achievement of America's motor-truck industry. And why? In the first place, it was conceived not by one man or one company, but by fifty of the master motor-truck engineers, each working with patriotic fervor on his share of a great task, each backed up by a company which had heretofore engaged in almost cut-throat competition. That these fifty experts representing competing firms have worked together harmoniously, picking out the good points of one design and often ruthlessly throwing aside pet hobbies which had been followed for years before, but which did not meet the requirements of war, is an exhibition of self-repression as magnificent as is the truck they designed. Long after the war the influence of these patriotic engineers will be felt. Not only the army but the business men of the country have profited by their co-operation. The commercial motor-truck will henceforth be differently built.

Photo © by Harris and Ewing

President Wilson Accepts the Liberty Truck

Although it represents everything new in design it embodies only tried and proved ideas

What is the chief merit of the new war truck? Why is it great? Chiefly because it is a standardized vehicle down to the last nut and bolt That is why it is a better product than any truck used at the front today.

The average commercial motor truck is r rugged enough to sta the severe tests of w: Our army enginee found this out in o effort to catch Villa the Mexican wilderne: Our trucks were go commercial product but they brol down. Th was but nat ral. Some v tal part w: just stron enough to giv sufficien overload capacity over fair to middlin roads and just weak enough to break an cause trouble under the excessive strair of war work when negotiating roadle: country.

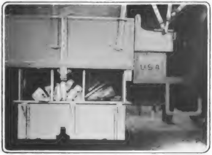
It is not strange that the average com mercial truck should fail under severe wa tests. It is primarily a business-man' money saver, for use only when it wil

The War Chariot of the American Army

Rugged and massive in appearance, the truck has worm final drive with a large gear reduction between the engine and the rear wheels, so that exceptional power may be had at slow speeds. It is fitted with the conventional caravan-topped army body, and with spring-supported wooden bumpers in front and at the rear to avoid damage in convoy formations.

deliver a ton of goods more cheaply than any other vehicle. Its weight is reduced to a minimum so that its power can be applied to actually moving the load, rather than to pushing itself over the road. Greater strength demands heavier and more rugged parts and this means greater weight.

Some truck makers wondered why it was necessary for the United States Army to have a special and more rugged conveyance, when our Allies across the seas were not only using the 54,038 commercial vehicles shipped to them from America between July, 1914, and July, 1917, but were continuing to order more each month. That was all a matter of sheer necessity. The repair-parts problem is stupendous, because of the inherent weakness of the average commercial truck for war work. The trucks couldn't be changed. A single change in design of any of the dozen or more standard makes sent to the battle front would mean the scrapping of thousands and thousands of dollars' worth of spare parts. Our trucks overseas are giving a good account of themselves; but they are not all that has been desired.



Stirrup Step and Storage for Spare Parts

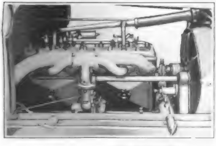
The clumsy automobile running board with its tool boxes and extra tires has been discarded

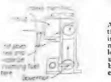
When our Allies bought American trucks they *had* to buy them, not because they were built in the right way but because trucks were vital necessities and America was the only country able to make and export them. To change even the smallest detail on any of our trucks now abroad would throw the entire repair parts system into chaos. Battles might even be lost if the system were disturbed.

But with the United States, it is different. We are entering the war at a time when we are able to apply every bit of truck experience gained by our Allies at the cost of much blood and money. This experience is embodied in the new trucks, the first two of which, were assembled in record time at plants in Rochester, N. Y., and Lima, Ohio, driven overland to Washington and accepted by President Wilson and Secretary of War Baker.

The weakest part of the new truck is stronger than any conceivable war strain that can be put upon it. It is more rugged that any commercial vehicle of like capacity. Its load is only three tons, and yet it is comparable with the five-tonner of every-day use. This is very important; for there will be neither time to make extensive repairs when the forward march on the West front begins, nor roadside repairshops at which to make them. A broken-down truck is a truck lost. Into the ditch it will go, so that the line of vital ammunition and supplies is not held up. Again, the shell-pitted roads of northern France, over which the advance will be made, will be boulevards as compared even with Mexico's roadless country.

In order that our new trucks shall not fail in this crucial test, the two already completed, will be tested to destruction between now and the first of January, 1918. Any weaknesses which might prove disastrous later on will be dis-

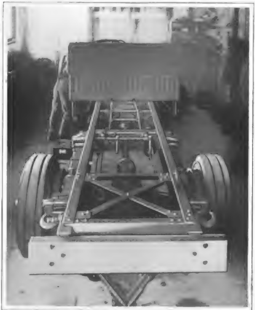




The Unique Gas-Saver

About three inches of the intake manifold is inside of the exhaust manifold, so that the low grades of fuel now used will be vaporized before entering the explosion chambers

covered. Following these tests, ten thousand of these trucks will be put together in a dozen or more plants before June 1 and shipped abroad in time to take their places behind the trenches with our armies, now in training. It will be simple to keep them in repair in France—simpler than any of the allied armies have found it with their trucks, burdened as the Allies are with several makes, each having its own peculiar characteristics and each requiring a separate supply of spare parts. This follows because our trucks are standardized. Now do you see what standardization means? There is nothing technical about it. It's just common sense—that's all. It simply means that every engine, every front axle, every rear axle, every change-speed mechanism or gearbox is interchangeable with every other similar part in every [illegible] truck. If the engine of one truck is [illegible]ay by a small shell and the chassis [illegible]mains intact, no drilling, boring [illegible]changes will be necessary in order [illegible]nother engine in place and put [illegible] on the road at once. This [illegible]ation is carried down to every [illegible] entire vehicle, including such [illegible] as magnetos, carbureters, bat[illegible] lamps and fuel tanks. Even the [illegible] of bolts and nuts have been [illegible] a minimum, some being made a [illegible] than necessary just so that [illegible] be carried is small.



In the standardized truck every part is interchangeable with a similar part in every other truck—front axle, rear axle, change-speed mechanism, gearbox and other parts, big and little. If the engine of one truck is entirely demolished and the chassis frame remains intact, another engine can easily be substituted without the necessity of any exhausting delays in making the new parts fit

The engine is fitted with two independent sets of ignition apparatus, one a battery unit and the other a magneto, so that if one gets out of repair, the gas can still be exploded in the cylinders by sparks from the other source. In brief, the truck is characterized by the ruggedness of its parts, the combination of the best ideas in its design and their mounting so as to be extremely accessible for repairs.

It is to be remembered that this truck is intended solely for the use of the Quartermaster Corps and that other standarized trucks are being built for the Ordnance Department, the Signal Corps, the Engineering forces and the Medical Corps.

The tests of the truck which have already been made have proved so satisfactory that late reports indicate that contracts will be let for its construction in large numbers without waiting for the more extensive trials.

The Heart Is an Astonishingly Powerful Pump

Your heart is a very busy organ. While you breathe once, it beats four times. At each beat it sends four pounds of blood through your veins and arteries. The weight of the circulating blood is twenty-nine pounds. When you run, your legs and the other parts of your body need more blood, so your heart must pump faster.

A Portable Dental Ambulance for Treating the Fighter's Teeth

AT the beginning of the war, the dental surgeon, so far as the Allies were concerned, was not officially recognized in army circles. Indeed, it was not until the Germans marched into Brussels, with a dental post every ten kilometers, that the Allies appreciated the importance of oral hygiene.

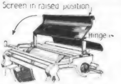
To-day there are eleven American dental field ambulances in France alone. Men, who were formerly sent home on sick leave, whose only trouble was their molars, are now kept at the front. Soldiers, to the number of a division and a half have thus been spared to the army. Furthermore, the surgeons insist that a wounded man with bad teeth makes a slow recovery. And then, too, army rations are hard to masticate, so that the man with poor teeth "bolts" his food and loses strength and endurance. In our new National Army there will be a dentist for every five hundred men.

The accompanying illustration shows a portable dental ambulance used in several National Guard camps.

© Int. Film Serv.

Twenty per cent of the injuries the soldiers receive are face and head wounds, which require dental treatment as well as surgical attention

The protective metal screen permits the typist and no one else to see what she is writing



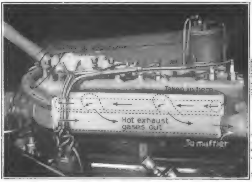
At the left the screen is shown raised. It can be adjusted to any make of typewriter

Foiling the Busy-Body with a Letter Screen

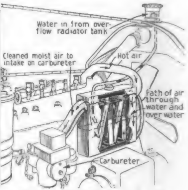
CURIOSITY often impels persons to read letters which have been left in the typewriter in a partly finished condition. Business secrets and information of a confidential nature are thus very often divulged. A simple and effective remedy is offered in a device patented by Henry R. Knowles, of Rudley Park, Pennsylvania. It consists of a metal screen, hinged through its center and fastened to the carriage of the machine. It is adjustable to any make of typewriter. By raising the forward part of the screen, the typist may read the letter or make corrections when necessary. When released, the screen will drop of its own weight and completely cover the letter in the machine, with the exception of the last two lines, which the typist can see from a sitting position. These lines can not be read by anyone standing behind or in front of the machine.

Washed Air for the Carbureter

An atmospheric stabilizer draws air from the exhaust manifold

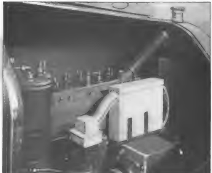


The hot air is carried through flexible tubing from the manifold surface to a dampener containing water and wicking, where it is thoroughly humidified



Showing how the water is automatically fed from the overflow of the radiator tank to the stabilizer

AUTOMOBILE drivers are well aware that the engine works more efficiently and more satisfactorily in the early morning and late evening when the humidity is high. Hence, it occurred to one inventor, to humidify the air as it is admitted to the carbureter and to do it whenever it was desirable. The atmospheric stabilizer, as the device is called, maintains the air at a uniform temperature, as it is drawn from (but not out of) the exhaust manifold, the hottest exposed part of the engine.



The space occupied by the atmospheric stabilizer is comparatively small

The hot air is conveyed through flexible tubing from the manifold surface to a dampener containing water and a wicking, which is automatically fed from the overflow of the radiator tank, as the accompanying drawing illustrates. Because of the arrangement of the wicking, the hot air must pass through water on the way to the dampener. This not only humidifies it, but also washes it free of dirt and grit.

The principal result of providing air properly humidified and at uniform temperature, is a smooth running, efficient engine. A secondary worthwhile result is a lessened consumption of gasoline.

Bullets Made of Paper Do More Damage Than Metal Ones

INCREDIBLE as it may seem, bullets made of paper will do much damage. A recent experiment has shown that a paper bullet, after having passed through six pieces of tin one foot apart, buckled them. A similar experiment made with metal bullets showed that they passed through the same thicknesses of tin but they made only a small clean-cut hole.

Taking the Staccato Bark Out of the Machine Gun

THE machine gun, properly hidden, makes its presence known only by a light blue vapor that is visible under certain conditions during firing, and by its noise, which is precisely that of the common pneumatic riveter used on structural steel buildings. At times the roar of firing, covers up this peculiar, harsh, regular, mechanical "Tat-tat-tat-tat"—but unless the firing is heavy the other side speedily recognizes the distinctive sound and looks for the gun. Can't the gun be silenced?

The most practical way of silencing firearms is to use Maxim's device, which consists of a steel cylinder larger than the barrel, attached to the muzzle of the gun. Inside the cylinder are steel disks set at a slight pitch, and with a hole pierced through them to permit the passage of the bullet. The gases, emerging under high pressure, expand into the silencer and are set to whirling, losing their momentum and much of their pressure and entering the air without causing a noise at the end of their whirling.

While the Maxim silencer is entirely efficient, it is doubtful if it could be applied to the machine gun, because the firing of six hundred shots a minute would result in loading the cylinder with the gas from another charge before the first had escaped, and wrecking the silencer from the intense pressure.

The Italians are said to have machine guns that make merely a low, dull thud instead of the revealing crackle.

The noise of a gun, contrary to common belief, is not something within the barrel, but merely the violent slap of gases at high speed and pressure, impinging on the air at the muzzle. A silencer whirls these gases

An American Fortune Spent for An English Invention

THAT there is just as great an opportunity for the inventor as there ever was, is vividly illustrated in the case of Frank Hornby, of Liverpool, England. Who has not seen the advertisements in nearly every American periodical of the mechanical toy, with which boys can build structures resembling bridges, buildings, derricks or ships? That toy is Hornby's invention—patented by him sixteen years ago and first thought of in 1899.

Hornby has a mechanical turn of mind. As a boy he was familiar with tools. It was for the two boys in his own family that he constructed the first early models of his toy. Finally, in 1901, he obtained his patent. There was nothing resembling it on the market. However, the trade did not enthuse over it. Hornby was working on a small salary in those days, and thus could not spend money for advertising. Fortunately, however, his employer became interested and assisted him in bringing the clever, new toy to the attention of the public.

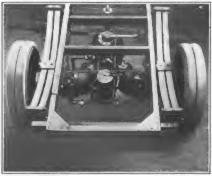
Seven years after he obtained his patent, $40,000 had been expended in exploiting the toy. Still a market had not been created. But Hornby did not lose his enthusiasm. The next year, 1909, the toy came to America and thereafter Hornby came into the fortune that was rightly his. During the first year a business of $7,000 was done in this country alone. The following year it jumped to $24,000. In 1911 it climbed to $49,000 and in 1912 it touched $114,000.

Using Oil Instead of Gears

Hydraulic transmission does away with most of the present day gearing of automobiles

HYDRAULIC transmission for automobiles is not new. But the type of hydraulic transmission described here is both new and revolutionary. It has been simplified, and then simplified further, until it does away with the clutch, change-gear, differential and brake on the automobile. Moreover, as it is now applied to certain makes of motor trucks, it is performing the function of an ideal speed control.

Among those who were instrumental in developing it, are the Chief Mechanician of the Navy, and two mechanical engineers, Charles R. Pratt and H. F. J. Porter. In its original form, this transmission is now used on many battleships of the different navies of the world. Because of its ability to impart a very large number of speeds, it has been found excellent for revolving turrets and for maneuvering guns which have to be trained upon an enemy's ship, dashing here and there over a zig-zag course.



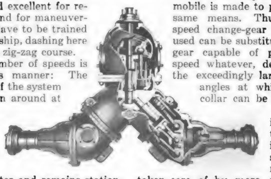
Why Gears Are Unnecessary

The oil between the hydraulic pump and the motors, being imcompressible, forms a rigid gearing which takes the place of the clutch, change-gear, differential and brake. To start, the driver throws over the controlling lever to full speed. The automobile gains speed gradually and without the slightest jerk. This is accomplished by an attachment which permits the pump collar to incline slowly as the automobile runs faster. Should the automobile be stopped abruptly, the collar is immediately brought back to its neutral position and the engine power is shut off automatically

The large number of speeds is obtained in this manner: The pump cylinders of the system are always driven around at the constant, full speed of the engine. The collar of the pump pistons is pivoted about the diameter and remains stationary. With the collar in the "dead" position, the pistons cannot reciprocate and no oil is pumped over to the hydraulic motors. But begin to tip this collar, and back and forth go the pistons, forcing streams of oil into the motors.

The more the collar is tipped, the greater is the amount of oil forced over. To take up this oil and to send it back again into the pump chambers, the pistons of the two motors start reciprocating. In other words, since the motor collars are stationary, the constant-stroke motor pistons start turning.

The motor cylinders that revolve are connected with the rear driving wheels. The rate at which the cylinders rotate depends upon the quantity of oil they handle in a given time. Since this quantity is increased by tipping the pump collar, it is obvious that the speed of the automobile is made to pick up by the same means. Thus, the three-speed change-gear now generally used can be substituted by a fluid gear capable of producing any speed whatever, depending upon the exceedingly large number of angles at which the pump collar can be tipped.



When turning a corner, the difference in the rotation speed of the rear wheels is taken care of by more oil going over into the motor connected with the outer wheel.

Glaze: An Old Winter Foe with a New Name

Sleet storms will hereafter be called glaze storms

This is Glaze

It has been with us since the beginning of time, but it was only a year ago that it obtained its christening from the U. S. Weather Bureau

Heavy as Lead

Not only branches, but telegraph, telephone and electric wires break under the heavy load. The deposits reach remarkable dimensions

Beautiful—But Destructive

The branches of trees and shrubs become encased in glaze, until the whole landscape resembles fairyland

LAST winter a new weather word made its bow in the daily press—"glaze." Occurrences of "glaze" were frequently reported, and some of the visitations of this atmospheric phenomenon occasioned damage to the extent of thousands of dollars.

In previous years the newspapers called it "sleet" or "ice" or "silver thaw." Glaze forms when rain is turned to ice by the low temperature of the objects upon which it falls. Here are some results of actual measurements. A twig 3-16 inch in diameter has been found to measure with its ice coating nearly two inches in diameter. One case is reported in which an ice-coated elm twig about six inches long, broken from the tree, weighed 15½ ounces. This was about five hundred *times* the weight of the twig alone. The coating on a slender telephone wire may attain a thickness of two inches and upwards. Indeed, cases are recorded in which the combined thickness of ice and snow on such a wire reached the enormous diameter of ten inches. No wonder hundreds of miles of wire and thousands of poles sometimes go down when glaze occurs on an extensive scale.

But why "glaze"? This word was introduced by the Weather Bureau over a year ago, because a distinctive name was needed for these ice deposits. The electrical industries had fallen into the way of calling this formation "sleet." But "sleet" means something different—or rather several things. This word is applied by some people, especially in England, to falling snowflakes mingled with rain. Now it must give way to "glaze."

Making Millions Out of Bubbles

Huge profits, undreamed of yesterday, are now obtained from the dump pile of low-grade ores

By George Merriman Oaks

Managing Editor of the Popular Science Monthly

MILLIONS are at stake in lawsuits brought about by infringement of the froth flotation patents. Clearly, they must be very important patents. In truth, they are the basis of a great industrial achievement. In one mine alone the flotation method increased the daily output of zinc by 200,000 pounds; in another, the daily increase in copper was 120,000 pounds. The adoption of froth flotation by the five leading porphyry mines of the United States would mean a yearly saving of $17,000,000.

What is froth flotation? Nothing but the industrial utilization of bubbles. Who would believe that bubbles could be turned to money—yes, millions? And to think of applying such ethereal objects as bubbles, whose greatest achievement has always been to grow a little bigger and then burst, to an industry like mining!

It seems as though Nature's most precious gifts are often hedged about with thorns so prickly that ceaseless labor is necessary to obtain them. We find copper combined with sulphur as copper sulphide. Furthermore, the sulphide is shaken up with all sorts of worthless mineral matter, such as sand and limestone, until it seems hopelessly hidden from man's reach. The same is true of the other base metals, zinc and lead.

The useless matter

Why Doesn't He Sink?

This water-spider floats, not because he is so light, but because of surface tension. With a little care, a needle can be floated in the same way

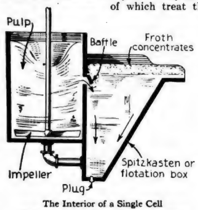
[illegible] Repelled Depending on Their Wetness

[illegible] only one of [illegible]. Pressure on [illegible] than that [illegible] on its right [illegible] the other [illegible] of body [illegible] (below [illegible] atmos- [illegible] the pres- [illegible] the body [illegible] other body

Attraction of two bodies wet by a liquid. Pressure is the same at all points indicated by dotted line, namely, that of the outside atmosphere. Pressure is less in the liquid between the bodies and above the dotted line. Therefore, the atmospheric pressure outside pushes the bodies toward each other. The liquid rises between the bodies due to the principle of capillary attraction

found in conjunction with the sulphides of lead, copper and zinc, is referred to as gangue. Concentration is any process of separating the valuable metal from the worthless gangue.

The simplest method of concentration is hand-shaking. We all remember our old American history which contained a picture of a flannel-shirted Forty-Niner "panning out" gold from one of California's rivers. He used an ordinary dish-pan, and by a careful shaking, slopped the water and gangue over the sides, the metal being allowed to settle.



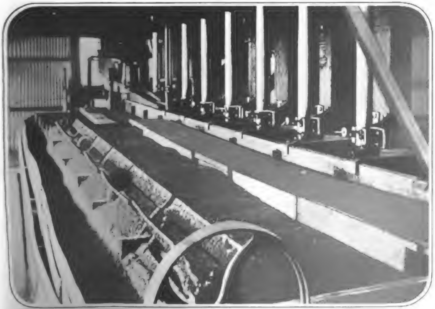
The Interior of a Single Cell

The pulp, consisting of sulphides, gangue, water and oil, is violently agitated by the impeller. From this chamber, it passes into the flotation box or spitzkasten. The froth, bearing the metal, is floated over the lip and the worthless gangue is then allowed to sink to the bottom

Various Methods of Concentration

Hand-shaking has long since been superseded by mechanical methods, some of which treat the ores wet, and some dry. Both take advantage of the difference in specific gravity of the gangue and of the metal. In the dry method, a current of air is used to blow away the lighter gangue, leaving the heavier minerals on a flat corrugated surface. In the wet methods, the ore passing through a stream of water separates into two parts, the metals sinking and the gangue being washed away.

But now comes a



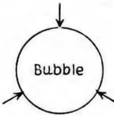
The Metal-Laden Froth After Running the Gantlet of Agitation Cells

The feed passes through two agitation boxes before [illegible] where the first concentrate [illegible] a paddle. The remaining [illegible] a pipe to the third agitation box. From this the pulp passes to the second spitzkasten, and so on down through the machine to the fourteenth spitzkasten. Discharge from No. 14 leaves the machine as tailing [illegible]

process which practically reverses the long-used wet method of concentration. Instead of sinking the sulphides, they are induced to float and the gangue is allowed to sink. Flotation is the term applied to this revolutionary method.

The history of flotation, like that of most great industrial processes, is not centered around any one man. Its development, though rapid, has involved a long list of patents taken out by a large number of American and foreign metallurgists.

The first patent which even suggested the process now known as flotation was obtained in 1860 by William Haynes. He knew that sulphides would stick to oil and in a crude way tried to use this principle in separating the metal from the gangue. He was followed by Bradford, whose method involved surface tension concerning which I shall speak later.



A Bubble Bursts by Crushing Itself

It is believed that surface tension acts like a rubber membrane over the bubble, constantly exerting an inward pressure which finally results in its collapse. That tension is reduced by the addition of a delicate film of oil or other viscous substance

The Floating Spider

The underlying principles governing flotation are too theoretical to admit of satisfactory explanation. The how is more easily explained than the why. Have you never observed the trim little water spider go skating across a pool with the greatest ease and agility? And did you make the mistake of believing that he was floating simply because he is so light? Then try floating a needle on the surface of a glass of water. It can easily be accomplished and you will note that the much heavier needle seems to lie in a sort of depression in the surface of the water and does not readily become wet. This is due to surface tension, supposed to play an important role in flotation.

In surface tension we have a tendency on the part of a liquid to act somewhat like an elastic skin, trying always to contract to the minimum area. A drop of water does its best to shape itself into a neat little round sphere instead of spreading out over a large surface. But this is only on surfaces which water does not wet. In contact with paraffined paper, for instance, it maintains the drop form; on the other hand, it quickly sinks into the meshes of a piece of blotting paper. If a needle is perfectly clean, it will sink; if it is greasy, it can be made to float. The explanation involves two phenomena, surface tension and adhesion.

Surface Tension Is a Force

Surface tension would at first give the impression that an actual film or skin were stretched over the surface of the liquid. In reality, the needle is supported by a force and not by the water itself. This is proved when the needle sinks—the water cannot hold it up.

There exists between the molecules of any body an attraction which holds them together. At the surface of a body of water, the top layer of molecules lacks an attraction from the outside. This lack is compensated by a greater attraction from below and from the sides. Thus a horizontal stretching is produced — called surface tension.

This force can be readily upset by bringing about an attraction from above so that the attraction of the top layer of molecules will be more nearly equal in all directions.

Now, water molecules are attracted by iron; consequently a clean needle becomes wet if brought into contact with the water. But water molecules are not attracted by grease; and so a greasy needle does not become wet—which means that a tiny film of air remains around the needle; and the molecules in the top layer of water are still attracted in a horizontal direction (surface tension) so that the needle cannot sink.

Sulphides are not readily wet by water. If crushed into finely divided particles, they tend to float because of surface tension. Gangue, on the other hand, is easily wet by water; consequently it sinks. This may be termed film flotation as distinguished from the newer and far more efficient bubble method known as froth flotation.

A Bubble Bursts by Crushing Itself

Consider the surface tension of a

bubble. Surface tension, as just described, applies to a level water surface. The surface of a quiet body of water is always level since the tendency is to reduce the area to a minimum. The same holds good in the case of rain drops and bubbles. A drop of water falling through the air becomes spherical since the sphere is the figure of least surface for a given volume. A bubble also assumes the spherical form for the same reason.

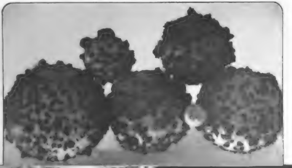
It would at first seem that some interior force causes the bubble to burst or explode. This is not so, if the prevailing theories are correct. It is believed that the surface tension acts like a rubber skin over a bubble, constantly exerting an inward pressure which finally results in the collapse of the bubble. If now we reduce this tension, the bubble will exist much longer. For this purpose, oil is added to the water containing the sulphides and gangue, but in very small quantity.

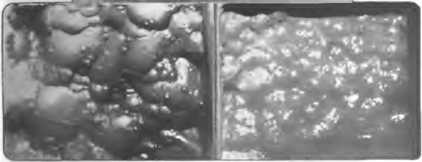
There was an earlier process using as much as three tons of oil to a ton of ore. In 1898, F. E. Elmore invented the so-called bulk-oil process. Strictly speaking, it was not a flotative process at all, the object being to recover the sulphides by using a very large quantity of heavy oil. The buoyancy of the oil was the sole agent in floating the metals. Sulphides, being wetted by sufficient oil to overcome the effect of specific gravity, traveled upward into the oil layer, and were consequently floated.

How the Army of Bubbles Work

In the froth flotation process only the faintest trace of oil is used. Briefly, the ore pulp, consisting of finely-ground ore particles suspended in a large quantity of water, is brought into contact with a minute quantity of oil. Through agitation, countless tiny bubbles are formed which carry the mineral particles to the surface with them, forming a dense froth several inches in thickness. The gangue sinks and is allowed to go to waste.

Injecting bubbles into the liquid by means of compressed air has been tried generally with less success than when the bubbles are formed within the



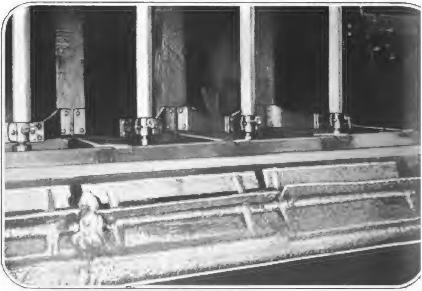


Photos by Charles Y. Clayton

Increasing the Lifting Power of Bubbles with Oil

At left: Cresylic acid froth. In this case the agitator has been stopped and the bubbles are beginning to coalesce. They are large and thin-filmed. At right is shown a pine oil froth, which usually has small bubbles. After the impeller has ceased its action, the froth coalesces into a scum

Above are shown bubbles of pine oil froth, to which are adhering particles of cassiterite (the oxide of tin). Pine oil is one of the best oils for flotation purposes, but it is costly. The creosotes, crude petroleum, and the coal tar oils have favor, sometimes with the addition of a small amount of pine oil



Froth Flotation Saves Vast Quantities of Base Metals Formerly Wasted

Myriads of glistening, dancing bubbles come surging along the surface of the liquid, crowding each other in their effort to reach the top with their precious cargo of mineral wealth. When Sulman, Pickard and Ballot discovered the froth process now in use, there was at Broken Hill, Australia, a 12,000,000-ton hill of ore which could not be recovered by ordinary methods. This ore was saved. When this issue reaches you, approximately 40,000,000 tons will have been treated since January 1917

liquid itself by violent stirring. The effectiveness of the two methods depends upon the physical characteristics of the ore.

Even when the mineral-laden bubbles reach the surface and burst, the metal particles are not allowed to sink because the bubbles directly underneath continue to buoy them up.

The floating of sulphides is greatly assisted by adsorption, which may be briefly defined as the tendency of gases or dissolved substances to cling to the surfaces of solid bodies. This results in a relatively high concentration of the gas or solution at the place of contact. The tiny particles of gas attach themselves to the solid particles, like barnacles to the hull of a boat. This film of gas surrounding the ore particles does not, of itself, possess sufficient buoyancy to raise the heavy mineral. But when it coalesces, or combines, with a few of the surrounding bubbles, the weight of the mineral is more than offset by the lifting power of the bubbles, and it comes to the surface. In this way, the bubbles "lay to" and together boost an ore particle to the top

Carrie Everson's Contribution

Adsorption was first applied by Carri Everson, who is regarded as the mothe of ore flotation, though she never receivec any material reward for her discoveries. She added the use of acid to the processes already developed by her predecessors. In her process, the acid, by combining with the metal, was thought to liberate gas which attacked the ore particles and buoyed them up. As a matter of fact, the acid gives the sulphides a clear surface to which the oil will adhere. When left standing, the ores often become oxidized and thus hinder the action of oil in concentration.

For years, a story has been told of the accidental discovery of flotation. A Miss Carrie Everson, a sister of an assayer located in Denver, while washing some dirty sacks, in which concentrate had been sent to her brother, realized that the grease and ore particles floated on the water,

and subsequently patented her discovery. So the story ran. Romantic, indeed—but, like many another tale of the beginning of some great enterprise, it lacked the verification of fact. In reality, Mrs. Everson was the wife of a doctor. She was a good chemist and her discoveries were the result of laborious experimentation.

Potter and Delprat, though working independently, devised a method also involving the use of gas in adsorption. During the next few years, the names of Froment, Cattermole, Wolf, Elmore, De Bavay, McQuiston and Bradford came into prominence through their efforts in improving upon the earlier methods of ore concentration by flotation.

But not until Sulman, Pickard and Ballot had conjointly rubbed the miner's lamp which evolved modern froth flotation, did the colossal outlines of this djinn of mining appear in its true significance.

These men were experimenting with the Cattermole process which used oil in the proportion of from forty to one hundred and twenty pounds per ton of ore. The oily metallic particles collected in clusters and then sank from sheer weight. The gangue was forced upward by streams of water and floated off. These men decided to see what would happen if the quantity of oil was reduced gradually to the vanishing point.

As the percentage of oil was diminished, the results became less and less satisfactory, until the process failed to work at all. Then to the amazement of the experimenters, upon stopping the agitation, myriads of glistening, dancing bubbles came surging along the surface of the liquid, crowding each other in their effort to reach the top with their precious cargo of mineral wealth. The oil had entirely disappeared from sight and touch. Investigation revealed the presence of the oil on the metal particles in a very thin film. The bubbles were extremely small and persisted longer.

At Broken Hill, Australia, where the experiments were performed under the supervision of Sulman, Pickard and Ballot, there had accumulated about 12,000,000 tons of ore from which the metals could not be recovered by the ordinary methods. The weight of gangue equalled that of the zinc and lead minerals present. Therefore, separation by gravitation methods was out of the question. While the Cattermole process would recover a reasonably large percentage of these metals, the newly discovered froth method gave unlooked-for success, and has been widely used ever since.

Is the Wind Right for Gas? Look At the Trench Weather Vane

© Western Newspaper Union

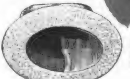
A weather vane made from bits of metal by a soldier at the front

THERE are weather vanes galore in the trenches and throughout the fighting area. Many of them are ornamental in design and plainly testify to the skilful fingers and artistic temperament of some of the boys. The one shown in the accompanying illustration was made by a Canadian soldier out of odds and ends of metal. It represents a cyclist and answers to the slightest breath of wind.

It is vitally important that the soldier know in what direction the wind is blowing or is likely to blow; for if it is coming from over the enemy's camp there is danger of a gas attack, and when the gas starts over, he has only from twenty to forty seconds in which to adjust his gas mask.

The Stormy Weather Hat—It Protects the Ears and Neck

EAR muffs are clumsy, and for this reason they have always been unpopular, even among those compelled by their outdoor occupation to wear them in bitter weather. So Henry Vaughan, of Montreal, Canada, has invented a hat with a soft woolen flap attached to the sweat-band. This does away with the necessity for the ear muffs.



The flap is shaped to fit the neck and to cover the ears

The woolen flap fits up into the crown of the hat when not in use; but when the wind is blowing a gale or when the snow flies, the wearer of the hat pulls down the flap and tucks it into his upturned coat-collar.

Yesterday, Invincible—To-day, Useless

ARMORED automobiles and motorcycle machine-guns are following closely upon the heels of cavalry in the present war; they are speedily going into disuse. There was a time when much was expected from these swift-darting steel forts, for theory had indicated that no infantry would be capable of stopping their advance. Could not these cars break through the enemy's lines on the field and [illegible] ... [illegible] round, [illegible] works of deep trenches. Since ordinary automobiles and motorcycles could hardly charge across these lands, no additional equipment of this kind will be made for the United States Army. During Pershing's campaign in Mexico, the motorcycle played an important part as a trustworthy vehicle for despatch riders. In addition to this duty, however, there were several motorcycles equipped with machine guns. Plans to organize a company of motorcycle machine gun operators were never carried out.

One Movement, and Up Goes This Sturdy, Collapsible Ironing Board

A SINGLE action suffices to set up or to fold a new type of ironing board, all parts of which are securely screwed or hinged together so that they cannot become separated. In setting up the board, the hinged central support is swung downward, requiring but one movement of the hand. Although the board is light and folds up compactly, it is firm and rigid when in use. A size smaller than that illustrated is made to fit into the modern housewife's kitchenette. When not in use the board may be hung up on a hook, the flat end first. This is done so as to prevent the supports from falling down.

[illegible] looks bulky but it [illegible] lapses after the man- [illegible] of a folding bed

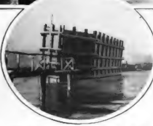
One movement suffices to set it up, ready for use

Launching a Bridge-Pier Caisson

The caisson was built on a scow, on which it was towed to position and from which it slid into the water

The caisson ready to be towed out to its final resting place as a support for one of the concrete piers of the bridge

The only lines necessary were those to keep the caisson from floating down-stream and the towing lines



The scow was divided by a bulkhead so that water could be admitted into one side to make the scow list as the caisson slid off

AN interesting engineering feat was performed recently at Manila, P. I., when a timber caisson for one of the concrete piers of the Jones bridge was launched in half an hour.

The caisson was built on a scow which could be tilted so the caisson could slide off into the water and be towed to its location where it was to be sunk and the concrete pier built inside of it. The caisson was 100 feet long, 35 feet wide and 36 feet high, longer and wider than an ordinary city house. Three feet above the lower edge of the caisson was a 4-inch calked plank floor supported by inverted timber trusses, which in turn rested on timber sills bolted to the upper edge of the concrete walls. The floor and trusses were designed to withstand water pressure during flotation. When all was ready, the valves on the midstream side of the scow were opened. When the caisson began to slide, the scow was pushed from underneath the structure. It was manned at once and sunk by opening valves in the eight compartments into which it was divided.

Twenty-three minutes after opening the valves, the list was fifteen degrees and the caisson slid into the water

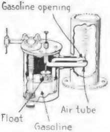
Due to the low center of gravity the caisson righted itself quickly and finally rested on an even keel in eight feet of water

Equip Your Automobile with the New Access-

Wire screens inserted as gaskets between the intake manifold and the cylinders act as gas engine fuel savers. Complete vaporization is thus secured

A folding automobile door is said to have many advantages over the old style. When it is closed the folding door is as safe as any

A safety lock which locks the shifter rods on top of the transmission case so that the gears can not be thrown into mesh and the car started without the owner's orders. Note the location of the key hole. The lock can be made to fit any of the modern clutch systems

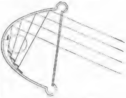


An atomizing carburetor primer to make the engine start easily. Air breaks up the liquid fuel

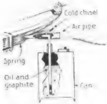
... comforts
The body
...nvas. The
...mmer cottage

Operating a washing machine by applying a crank and pulley to the crankshaft. It only takes a moment to attach them

A windshield with apron for the motorcycle, affords complete protection for the driver and prevents any backdraft. The shield can be easily disconnected, yet it will stand the most violent vibration without breaking from its fastenings



At left and above is a slotted fan-shaped headlight glare dimmer. The light rays are thrown to the top of the reflector and then deflected downward and out



Lubricating springs by forcing oil between the leaves under air pressure

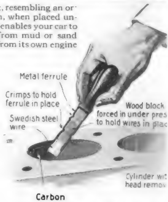
The unusual body, shown above, carries all equipment necessary to repair damaged or wrecked automobiles quickly on the road

The giant army truck, at right, has two radiators, steepled one above the other, to [illegible] run loaded in hot weather

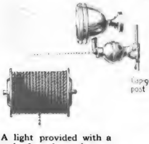
The Latest Appliances Which Will Help

A portable track, resembling an ordinary tire chain, when placed under a rear wheel, enables your car to extricate itself from mud or sand with the power from its own engine

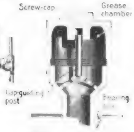
Why not grind your feed by applying a shaft and pulley to the crankshaft?



A carbon-removing brush of stiff ste wires held in place by a wood plu It is operated through the spark-plu hole or, more conveniently, throug the cylinder head, to clean the entir explosion chamber. The loosened ca bon is then blown out in the usual wa

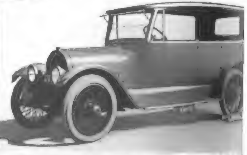


A light provided with a reel of cord can be carried to the rear of the car



A new grease cup with non-stripping threads, has a central guiding post

This sharp-pointed clamp is a protection against thieves. It is closed by a lock near the rim. The other end is hinged

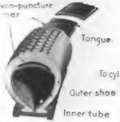


Metallic shipping shoes for automobiles, which hold the rear tires off the floor and at the same time hold the car securely in its moored position

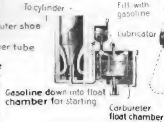
Your Automobile Into the Super-Efficient Class

Contractors are attaching rear cars to their motorcycles to carry a complete line of tools and equipment. Twelve-foot lengths of pipe can be accommodated

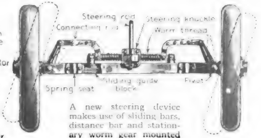
Behold the new form of hat for women, which makes goggles unnecessary. The simple peak device deflects the air currents



A non-puncture liner for pneumatic tires. Steel sections are used between the casing and the tube



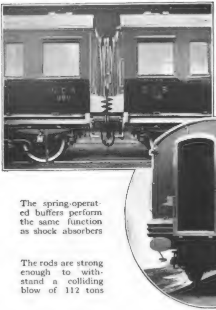
A lubricating cup for gasoline is used in starting a motorcycle using kerosene



A new steering device makes use of sliding bars, distance bar and stationary worm gear mounted **on the axle of the car**

In Grand Rapids, motor-trucks will thaw out frozen hydrants this winter. Steam boilers, mounted in the position shown above, will do the thawing

So that you can ride over a curbing in your automobile, two boards are attached to string pieces, the top one being supported by the curbing



The spring-operated buffers perform the same function as shock absorbers

The rods are strong enough to withstand a colliding blow of 112 tons

Preventing Cars from Telescoping by Means of Collision Buffers

IN many railroad accidents the amount of destruction of life and property is considerably increased by the telescoping of the cars, one into the other. Due to the very rigidity of the cars, the force of the impact which meets the first car is transmitted to those following.

This is due to the lack of suitable cushioning apparatus between the cars. If some sort of workable absorber were placed near the coupling, the shock of the collision would be diminished as it traveled along the line. The first device would take up a portion of the blow and the second would take up still more. By the time the concussion reached the fourth car it would b rendered quite harmless.

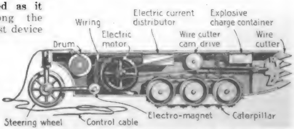
The principle is being put to practica use on the Great Central Railroad, i England. Buffing rods attached to powerful springs are being used with success

It's a Land Torpedo and It Eats Barbed Wire

THE land torpedo illustrated below is the interesting wartime invention of Henry E. Elrod, of Dallas, Texas. It has been designed to travel on land, under the control of an operator who may remain at a comparatively safe distance from the enemy. The torpedo is caused to advance, and turn to left or right, as circumstances may require, by the manipulation of an electric switch. The explosive charge is in the head.

Electric current is supplied to the motor in the torpedo through the operating and control cable. This cable is wound on a drum and paid out as the torpedo advances. The caterpillar method of locomotion is employed.

When the nose of the torpedo encounters barbed wire entanglements, the operator immediately causes its steel wire-clipping jaws to gnash, cutting an opening large enough for the head of the torpedo to force its way through. The shape of the torpedo is similar to that of the bow of a vessel, so that the opening in the barrier will be enlarged as the torpedo goes forward. Its sides are perfectly smooth, and entirely free from projections.



An electric switch controls the movement of the land torpedo and accurately guides it. The operator remains at a safe distance away

The Miniature Farms and Vineyards of France

ON the islands of Ré and Oléron, near La Rochelle, France, are found the smallest farms in the world. Some of them are only one or two square yards in area, yet these tiny domains are carefully planted with a variety of crops, even including vineyards. The soil is extremely fertile. The repeated subdivision of estates among heirs and the dense population of the islands explain the existence of these Lilliputian properties.

Light Your Gas with Electricity—It Saves Waste

AN invention recently patented by Frederick C. Gutenberger, of Sacramento, Calif., seeks to do away with the use of matches for lighting the gas in range burners. The device consists of an electric battery or other source of electricity, one pole of which is connected with the top plate of the range. A wire connects the other pole with a coil to the other end of which is attached a wire of convenient length, ending in a pin. The wire going through the pin is in firm contact with a copper tip, somewhat smaller in diameter than the end of the pin into which it is screwed. When the gas is turned on and the burner touched for a moment with the copper tip of the pin, a spark will be formed by the closing and breaking of the electric circuit, and the gas will be ignited at once.

The coil, enclosed in a protective box, is fastened to a small board, which may be hung upon the wall near the range. A small hook screwed into the board will accommodate the lighting pin when it is not in use.

To light gas with a match is slow compared with the swiftness of electricity

The concrete box safeguards the tree and very much enhances the beauty of the street

Concrete Flower Boxes to Protect Exposed Tree Roots

WHEN Marengo Avenue in Pasadena was extended recently, the grading incidental to the paving, left a lot of fine old pepper trees with some of their roots "high and dry." In fact, the exposure of the roots was so great that the city forester feared that the trees might be killed or their health seriously impaired.

Accordingly, to insure the safety of the trees, concrete boxes were built round the trunks and were then filled with rich earth. Plants with beautiful foliage were afterward set in the boxes.

Mr. Chinaman Must Have His 'Melican Cigarette

TEN years ago we exported four hundred million cigarettes to China, which is an average of about one cigarette a year for each Celestial. This year there has already been an average of ten cigarettes exported to each Chinaman, or, in round figures, four billion American cigarettes. Last year our exports in cigarettes alone reached the twelve million dollar mark.

The Electric Floor-Scrubber—It Saves Human Energy

IN a certain office building in Chicago, where fifty-six thousand dollars a year had been spent for floor cleaning by the hand method, the electric floor scrubber, illustrated here, has cut the cost of the work in half.

The electric scrubber is divided into two parts—the scrubbing machine proper and the wheeled mop and wringer.

The motor-driven scrubber washes the floor, while the mop sucks up the dirty water and deposits it in the tank at the rear

The operator of the machine plugs the electric cable leading to the machine motor into a socket on the wall. With the turning of the controller near the guide handles, the motor spins around, turning the eight weighted brushes around with it. Powdered soap and water from special holders are sprinkled in the desired quantities just ahead of the brushes.

The scrubbing machine is driven by its own power. The motor connects with the driving wheels by a worm and wheel arrangement under the carriage, so that the machine scrubs along at a pace of a hundred and twenty feet a minute. While the brushes—ordinary scrubbing brushes—spin around, scraping and washing all dirt from the floor, the electric cable feeds from the drum mounted beside the motor. The gear connecting this drum with its motor lets out the cable in such a way that no slack wires lie loose on the floor.

The mopping machine, which like the scrubber, is the invention of George W. Meyers, a mechanical and electrical engineer of Chicago, is even simpler in construction. It is wheeled along behind the scrubbing machine and by means of a duplex plunger, it sucks up the dirty water and powder.

Mooring the Rotted Telephone Pole to Prolong Its Usefulness

THE ever increasing cost of lumber has led to the use of many devices to save wood. One of the most ingenious is the method to save telephone poles, which rot at the base just above and below the surface of the ground. The upper portion remains sound for a longer time than the base.

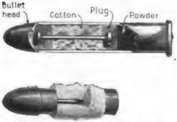
To make the old pole last longer it is moored to a short pole treated with creosote

A short pole, creosoted so as to withstand decay, is placed in the ground beside the old pole and firmly fastened to it. This adds several years to the length of time the pole will serve. The arrangement also serves as a protection to pedestrians; for since the part buried rots long before the upper part, the fall might occur most unexpectedly.

Cleaning a Rifle Barrel by Shooting a Cartridge Through It

A MAN in Helena, Montana, has devised a cartridge that cleans a rifle barrel. He uses an ordinary lead bullet, connected by a short rod with a lead plug which is set against the powder charge. The space between bullet and plug is filled with compressed cotton, which expands and rubs along the bore, wiping out the loose fouling.

A very serious objection to this plan is that the powder charge is behind the cotton, and deposits a new load of dirt in the bore. Moreover, rifles firing smokeless powder can not be cleaned without nitrocleaners. Neither is the plan practical for guns shooting the modern black powder.



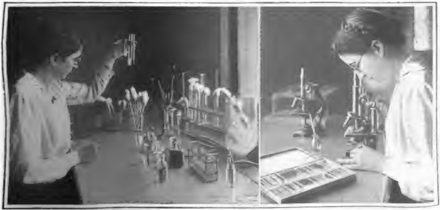
Compressed cotton rubs the bore, wiping out the loose fouling

What Spinal Fluid Tells About Our Soldiers' Health

IF one of the soldiers stationed in or near New York city is taken sick and his symptoms give rise to the suspicion that he is suffering with meningitis, word is sent at once to the Meningitis Division of the Department of Health of New York city. A physician from this Division goes to see the patient and to consult with the physician in charge.

After both physicians have made a thorough physical examination if it seems advisable, a puncture is made, to obtain the spinal fluid for examination in the city's research laboratories. If the patient is suffering from purulent meningitis, which is meningitis due to the presence of certain germs, the fluid will be cloudy. In cases of tuberculous meningitis, infantile paralysis, pneumonia and infectious diseases the fluid is clear. If it is cloudy or if the physician suspects that the disease is a case of epidemic meningitis, serum is administered. Even if the case is not epidemic meningitis the patient cannot be harmed by the serum, and if it is, a great deal is to be gained by prompt administration of the serum.

The number of injections vary greatly. Generally not less than four must be given and frequently many more are necessary. The serum is never administered by syringe but by gravity. The spinal fluid is examined thoroughly and there is no room for doubt about a case when all the tests have been completed.

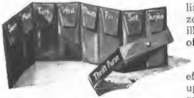

At left: Making a culture from the spinal fluid of a soldier suspected of having meningitis
At right: Making a microscopic examination at the New York Department of Health

This Purse Will Teach Your Boy to Save

IF you want your boy to grow up with a clear idea of the value of money, buy him a purse like the one illustrated.

The purse is made of a long piece of leather sewed to provide eight pockets, one for each day in the week and one for savings. The boy divides his allowance into seven parts and places it in the seven compartments, named after the days of the week. Each night he should endeavor to have a little money left in the compartment marked with the name of that day. This is transferred to the eighth pocket, which is his savings bank. The eight pockets fold together compactly so that the purse will fit a boy's pocket. Each compartment has a flap which fastens with a snap.

The thrift purse has eight compartments, one for each day's allowance and one for savings



A New Truck for handling Five-Hundred-Pound Rolls of Linoleum

A NEW departure in the shop trucks, utilized to handle heavy rolls of linoleum, has sprung into favor in many factories and department stores. No ordinary two-wheeled, straight-backed truck is this. It has a four-wheeled chassis and a back which consists of three rollers, so that the handling of the rolls is easy.

When a five-hundred-pound roll of linoleum is to be carried from one place to another, the lip of the truck is slipped under the end of the roll and the whole is simply pushed along on the wheels. It is not necessary to tilt the body of the truck, nor to support the load.

The entire weight is borne by the truck itself, and the four wheels, which run easily on ball bearings. When the man who is pushing the truck wishes to let it down, he simply lets go of the handles, guiding the handle-end of the truck to the floor. The weight of the linoleum bears it down, so that no force is required on the part of the truckman. The handle end of the truck is provided with two folding legs on which that end rests when the roll of linoleum is to be brought to a horizontal position, as it must be for cutting.

When the oilcloth or linoleum is in the horizontal position, as in the illustration below, the end of the cloth can be pulled out from underneath the roll with little effort. Less space is taken up in the operation than was formerly required.

Of course, this truck may be used for any heavy carrying which, without its aid, would require the labor of two men. As the labor shortage is so acute at present, this advantage is one to be especially considered during these war days.

...of the chassis
...on the chassis

The throw of the tripping lever unlocks the body and dumps it at the proper side. The load slides off. The body is brought back by means of roller bearings

This Type of Self-Propelled Truck Saves Even the Labor of Unloading

TO the long list of uses for the efficient little self-propelled electric truck—is added that of general hauler around factories. By the simple addition of a dumping body, the truck is now able to move everything from bricks to the actual factory products, with great facility. In the small space under the truck-body it carries an electric motor and power plant of storage batteries.

A load, weighing as much as a ton and a half, can be placed in this little body. The truckman then leaps upon the front of the truck, throws in the switch and turns the starting lever. This starts the truck, and the cargo is sped on its way at the rate of seven miles per hour. When the destination is reached, the car is stopped, and by means of a tripping lever the body is released and dumped at the proper side. The body is then brought back by means of roller bearings.

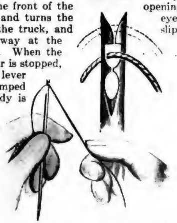
When flat or large loads are to be carried, the body can be removed and the ordinary platform can be substituted for it. The truck can further be utilized as a tractor. In this capacity it will very easily haul any load up to nine or ten thousand pounds.

A Needle That You Can Easily Thread in the Dark

NO matter how good your eyes are, there is always a certain amount of eye strain in threading a needle. If your vision is not as sharp as it once was, it is even something of a task to get a piece of thread through a needle's eye.

A needle has been devised which can be threaded by the simple expedient of looping the thread over the head of the needle and drawing it downward. The needle differs from the ordinary needle in that it has an opening through the top of the eye through which the thread slips when it is drawn downward. The steel ends spring close together as soon as the thread has passed into the eye.

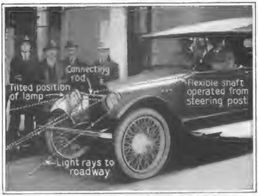
This type of needle is said to be particularly adapted to the doing of fancy work because two or three threads may be passed through the eye at one time, a feat that is quite impossible with the ordinary needle. It is also useful for embroidering with worsted, the thick, clumsy threads of which make it necessary, usually, to employ a needle for the purpose which has a large clumsy eye.



The thread slips through an opening in the top of the needle which closes as soon as the thread passes into the eye

Tip the Lamps to Stop Headlight Glare

Night and a curve in the road? Pull the lever and swing the lamps



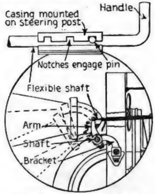
The lamps are set at an angle which will brightly illuminate the road without unnecessary glare

DEVISED to eliminate the disadvantages of the various types of automobile headlight dimmers now on the market, which either do not prevent glare or reduce the light to such an extent that it is not sufficient for country driving, a system of tilting head lamps has been invented.

It enables the driver to set the lamps at any desired angle so that the light may shine fully upon the road with the rays parallel or at an angle to the ground. The tipping head lamps also enable the driver to quickly secure the full headlight illumination after the use of the dim headlights. This is of especial importance in country road driving when it is essential to dim the lights upon passing another vehicle and to resume the full brilliancy immediately afterward.

Although the invention may be applied to any make of car, the design shown in the accompanying sketches, is particularly adapted to Ford automobiles and may be applied to them simply by the removal of the ordinary head-lamp brackets.

The device consists of one transverse shaft carrying two headlights and mounted in two bearings bolted to the front frame member in front of the radiator. A bell-crank lever arm is keyed to the shaft and is pushed backward or forward by means of a flexible metal shafting inserted through a hole cut in the radiator core and then carried to the rear under the motor hood to a point on the steering column directly below the hand wheel. The lamps are tilted downward from their vertical position by twisting the flexible shaft slightly on its axis so that a pin driven through it near the end on the steering column is enabled to slide in a slot with three notches cut in the casing over the cable end. A longitudinal movement is then given to the shafting by means of a small handle so that the bell-crank lever is moved forward or backward. When the handle is again released, the pin will quickly spring back to the next notch by reason of the energy stored up in the flexible shafting resulting from its being twisted. A further movement of the handle tips the lamps to a still greater degree while the longitudinal movement in the opposite direction similarly brings the lamps back to their normal position. The operating lever is so easy to turn that the driver need not divert his eyes from the road to manipulate it and move the light where he wants it.



The mechanism which moves the lamps at the pull of a lever

Like Water from a Hose

The asphaltic material is heated and applied under pressure from a gasoline-driven rotary pump

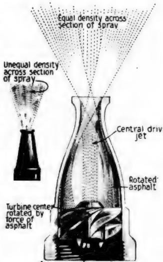
A method of Spraying Asphalt by hand—good for tight places

A NEW type of nozzle, made by a Boston manufacturer, is designed for spraying hot asphalt-binder in road construction or on sidewalks, where the use of a large motor-truck outfit would be unsuitable. The hot fluid is uniformly sprayed at a temperature of 350 degrees Fahrenheit and at a pressure of forty pounds per square inch. The high pressure causes the asphalt to permeate all the voids between the stone, which it is intended to bind. The portability of the apparatus makes it possible for this to be accomplished easily. With a motor-truck it would be almost impossible to reach the corners.

The sprayer can also be used for patching holes in bituminous roads and for applying roof coatings.

The asphaltic material is heated in the usual manner and put under pressure by means of a gasoline-driven rotary pump. It is then carried to a special nozzle by means of a hose. The nozzle has a fixed turbine center which disposes of the liquid in such a way that a dense uniform spray is obtained. This prevents the material from being too thick in some spots and too thin in others.

The turbine in the nozzle is stationary, yet removable, and gives a part of the liquid passing through it a rotary motion. This portion is driven out through the orifice of the nozzle by the central driving jet.



The nozzle has a turbine center which controls the density

The liquid asphalt is carried to the special nozzle through a hose. The nozzle sends it out in a solid conical formation of equal density across its section

The Soldier's Belt Is a Chandelier. It Even Holds His Flashlight

A GLANCE at the accompanying photograph shows how completely equipped the United States soldier is for emergencies. His hands are free, his gun is ready and he is literally "girded for the fray." The belt that "girds" him is an important part of his uniform. Only the wearer knows all that it carries attached to it. It is not the ordinary cartridge belt, but is the one used while on special duty or for comfort and convenience around the camp.

The special feature which this photograph shows is the flashlight fastened to the belt and held in position to throw its light directly ahead. The man on sentry duty will see the advantage of this arrangement, as well as the busy boys in camp who must often clean their guns after nightfall.

The flashlight is fastened to the belt, so that it throws its light straight ahead

Clearing out Sewer Pipes with Compressed Air

BRADFORD, England, has a sewer five miles long with a drop of 70 feet in distance. The grade is not uniform. As the sewage is loaded with heavy, solid matter, the flow was not what it should have been. The city did not want to resort to pumping because of the expense. One of the city engineers hit upon the idea of using compressed air at a pressure of eighty pounds and discharging it at regular intervals into the sewer. The plan was carried out with great success. It has been done for some time now without a recurrence of the difficulty.

Another Automobile Kitchen to Follow Our Boys at the Front

FEEDING our soldiers is an important matter, and the problems it presents have interested many of our inventors. The traveling kitchen, run by motor power, is a very natural product of the times. There are several types. One, which the United States War Department is considering, is shown in the accompanying illustration.

The kitchen with its big kettles, large enough to cook food for two hundred and fifty men at one operation, is mounted upon an automobile truck, which can also carry reserve supplies to feed two hundred and fifty additional men.

For the chauffeur a protected cab is provided in front and the cook may attend to his work in the kitchen even while the truck is moving from place to place, by standing upon a step in the rear. To prevent his being jolted off on rough roads a hand rail has been provided to which he can hold.

© Press Illustrating Serv.

One of these automobile kitchens can cook food for two hundred and fifty men at one time

Studying Germs on Wheels

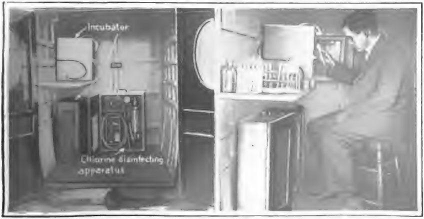
Climb on board this automobile and see if the water you drink is pure

The laboratory on wheels is the family doctor for New Jersey water systems

SCIENCE has made wonderful progress in devising methods of quickly discovering sources of danger to public health by the pollution and contamination of food and water supplies, and has found means of counteracting the dangers threatening from germs and other impurities. But promptness of action is imperative in all cases, and in recognition of this fact, the efforts of the health authorities in all states have been directed toward finding some means of expediting the work of the health officials and enabling them to cover every locality requiring their services without dangerous delay.

The Department of Health of the State of New Jersey has recently introduced a traveling field laboratory mounted on a motor chassis. In outward appearance the vehicle resembles a delivery wagon. The closed and covered body has doors in front and in the rear, and forms a small room used primarily for bacteriological work. On one side of the inside wall is a bench or shelf upon which rests two incubators which are heated by electricity from a storage battery, which also operates the starting and lighting system of the automobile. The shelf also provides enough room for the making of culture plates and for their examination for the purpose of counting the germs. The incubators may also be removed, and, by changing the voltage of the heating lamps, may be used on any 110-volt circuit at any water-pumping or filtration plant.

Another portion of the equipment carried by the automobile is a portable chlorine gas disinfecting apparatus by means of which any water supply found to be unsafe may be purified by the addition of chlorine gas. By means of this traveling laboratory the necessary inspection of dairies and water supplies in various remote parts of the State has been greatly expedited.



The interior of the laboratory. At left appears the chlorine gas disinfecting apparatus and at right an inspector is shown making a chemical analysis

A Medicine Cover Which Eliminates All Guesswork on the Part of the Nurse

MEDICINE that is to be taken a spoonful at a time, at intervals, should always be covered, especially if the sick person is lying in a room where the windows are open and dust enters. It is also equally important that the doses be administered at the precise time stated by the physician. It goes without saying that beneficial results can not be expected when medicines are administered irregularly, which is so often the case when memory is relied upon or where there are several persons waiting upon the sick one.

The minute and hour hands on the cover tell the nurse exactly when the medicine should be taken

A medicine cover which will remind you when the next dose should be taken, is a recently marketed article. The face of the cover, which is made of wood, is neatly colored and numbered from one to twelve in clockwise fashion. An hour hand and a minute hand are pivoted to the center. It is topped by a sympathetic appearing little figure by which the cover is lifted. After each dose is administered, the hands are set forward to the proper time for the next dose.

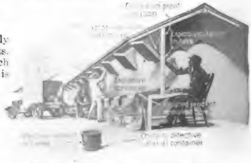
Shielding the Munition Worker Behind Steel Walls

FILLING the large shells is not the only dangerous task in the munition plants. Loading the shell primer and fuses in which only a very small quantity of explosive is used, is almost equally hazardous. A defective fuse, for instance, is likely to go off and to ignite piles of fuses and powder that are near it. This source of danger has been found so great in the experience of E. P. du Pont, of Wilmington, Delaware, he has designed a special loading house to protect the workers.

The operator is separated from the explosive material by a steel partition. Only the few grains of powder required to fill one or two fuses are at hand. If these grains go off, little harm is done. If the big piles should be accidentally ignited, practically the entire force of the explosion would be spent in the open air, on the other side of this partition.

The trucks that handle the powder supply and that take away the stacks of the finished products, all run on the outside of the partition, which is really the outside of the building. The loose explosive is placed in the large conveying trays that are shown. By tapping these slanting trays, enough powder slides through the little neck of the tray to allow for a few fillings. This powder is then wrapped up in the fuse fabric and the product is immediately passed out on another tray near by. Fuses, that are wrapped too tightly or are made imperfect in any way, are slid down a chute into a shallow bucket to be taken away. In this way no one touches the dangerous parts.

The entrance of women workers into munition factories has inspired many foremen to make extra humanitarian efforts in behalf of their employees and those dependent upon them for support.



As a protective measure, the workers are separated from the piles of explosive material by steel walls

A New Joint Box Which Prevents Submarine Cable Breaks

THE new type of joint box, shown in the accompanying illustrations, has just been devised to prevent breaks at the joints, or splices of submarine telegraph and telephone cables, caused by the severe mechanical stresses set up in the cable because of the constant movement carried on by the tides and currents.

The new joint box which prevents breakage of submarine telegraph and telephone joints or splices

Details of the joint box. Two double clamps are fixed to the cable, one on each side of the joint

The box, which is made in two halves, is bolted together with a gasket between the two parts, in order to make it waterproof. Two double clamps are attached to the cable, one on each side of the joint and outside of the joint box proper. These two clamps are held in the proper relation to each other by means of four long take-up rods and nuts, which, when tightened up against the ends of the box, bridge over the joint and transfer any stress on one side to the other without causing any strain in the lead sheathing over the actual cable joint.

Bury the Coffee-Grounds in the Garden. They Fertilize the Soil

THE question of what to do with the coffee-grounds has at last been satisfactorily answered. Just pour them out into the sink-strainer and dump them into the garden. They contain some valuable fertilizing properties, including a large percentage of nitrogen and a fair amount of potassium and phosphorus.

How the First Potatoes Were Made Popular in France

ALTHOUGH potatoes were early introduced into Europe by the Spaniards, they did not come in any quantity for many years. The English found them in Virginia, but it is believed that the Spanish brought them to that colony from further south.

The first attempt to introduce them into France was due to a well known scientific authority named Parmentier. This was in the seventeenth century. He imported some of the plants, set them out in a field near Paris, and by means of learned pamphlets and talk with the people, tried to have the new vegetable brought into cultivation and the market.

But it was all in vain. Potatoes did not prove attractive; and when the planted ones matured, it seemed that they would rot in the ground on account of the prejudice against them.

Then some wise man who knew human nature—a student of psychology, with practical ideas—suggested that peasants could not be made to try potatoes by persuasion, but might be led to adopt them if they were forbidden to eat them.

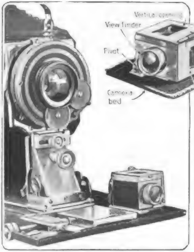
His idea was adopted. Many signs were painted and erected in plain sight, forbidding under severe penalties any one from taking any potatoes from the field.

The peasants at once began to raid the hills; and before long most of the ripe tubers were stolen and eaten with relish.

A Masking Device Which Brings the Whole Picture in the Photograph

EVERY once in a while the amateur photographer gets into trouble by turning his camera over to take a lengthwise picture, using the up and down, or the panel portion of the finder, to locate the object or person to be photographed. This often results in an unfortunate headless and footless portrait of the camera fiend's best friend. Two citizens of Indiana have invented a masking device which makes it impossible for even the most careless person to make such a mistake.

The device covers the top of the view finder, as the illustration shows, and permits the photographer to see the scene only as it will go on the plate or film. This effectually prevents the using of the wrong length of the finder—the panel portion for the horizontal picture.



The masking device fully covers the top of the view finder

A hinged flap contains the vertical opening for one position and another contains the horizontal opening. When the finder is rolled over, the vertical opening flap turns down beside the finder box and the finder moves until the ninety degree turn is complete and the hinged flap carrying the horizontal opening lies exactly across the screen.

There can never be even the possibility of a mistake with this device, because the shape of the opening over the focusing plate is automatically altered by the change in the position of the finder. By this simple means, inexperienced photographers may avoid many disappointments.

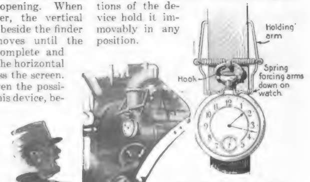
The Engineer's Watch-Holder — It Hangs the Watch in Any Position

TO the engineer, the most practical timepiece is one which can be used without loss of effort and time. For this reason, a watch-holder invented by Frank J. Ellis, of Philadelphia, should meet with his approval.

The device consists of a central bar on which two members are pivoted — one for attaching the device, and the other for holding the watch in the device. Both members are of spring wire, the attaching arms being sharpened at the points to grasp the support.

The watch-holding section is in one piece, the wire being coiled around the pivoting bar, forming a hook at the center of the bar and a U-shaped spring in the loop of the wire. In use, the ring of the watch catches over the hook and the stem of the watch slides into the U-shaped spring.

The tension of the various spring portions of the device hold it immovably in any position.



The attaching arms of the watch-holder are sharpened so that they will "bite" any wood support

Firing Bullets from a Slot at the End of a Shotgun

The muzzle is flattened out so that the bullets issue in a horizontal line

FROM the time British sportsmen learned that hitting flying things was entirely possible, there has been a hundred years of endeavor to make a shotgun fire its shot charges more compactly, to the end that the density of the "pattern" be sufficient to insure hits even at very long range.

Now comes an inventor with a device to make a shotgun spread its charge even more than the normal "cylinder" barrel, and not only to make it spread, but to produce a spread of a certain shape so as to increase the chances for a hit.

For war usage, this inventor has produced for the shotgun, a muzzle flattened horizontally, until it is nothing more than a slot of a width equal to the diameter of the buckshot to be used; and of course running horizontally as the gun is held by the shooter. The result, says the inventor, is a "pattern," made with twelve buckshot, fourteen inches high by eight feet wide at a distance of thirty yards. In other words, at this range the gun shoots a horizontal line of round bullets, not one of which is higher or lower than seven inches from the average, all traveling in a "line of skirmishers," eight feet wide. Were men charging the trench at yard intervals, which is not now true, three or four of them would be hit with a bullet each. The device can be applied to cannon also, the load being changed to a charge of loose leaden bullets and the muzzle flattened out to allow them to pass out in a horizontal line only.

For game shooting, what is needed is a little lever for quickly changing the horizontal position to a vertical one. Where the crossing duck or quail would have to run the gauntlet of a shot charge spread out, say, fifteen feet from east to west, the walked up game, rising suddenly, or the soaring duck, would call for a vertical position of the flattened muzzle.

An Open Fireplace On the Veranda—What Next?

A cobblestone fireplace with a brick chimney built into the wall of the veranda is an attractive innovation

IN Los Angeles, Cal., the hottest day is followed by a cool evening. Hence the open-air fireplace is not so incongruous as it seems. It has been built into the corner of the veranda, the low walls of which are of cobblestones. The fireplace itself is of the same construction, with a brick chimney extending high enough into the air to conduct the smoke cloudward.

Here on cool evenings a bright log fire is built, which makes it possible for the residents to enjoy the out-of-doors.

A one-man monorail for conveying boxed automobiles from the shipping room to the railroad siding

As Good as Ten Strong Men

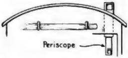
CONVEYING systems which are very costly to instal, become good investments when there is a shortage of labor. An example of this is the long overhead monorail erected in a Toledo, Ohio, plant. The electrically operated crane is handled by but one man. It carries boxed automobiles from the [illegible] the flat [illegible] when [illegible] of [illegible] [illegible]

A Periscope for the Engineer in His Cab

INVENTIONS previously used exclusively for war purposes, are now finding their way into industry. Even the submarine, associated with destruction, has something to contribute. For instance, why not periscopes for railway engineers? Why is it necessary for the engineer to lean out of his cab to see the track ahead of him, or the signal of the conductor or flagman in the rear of the train?

According to A. G. Spencer, of London, England, periscopes would be a great help to all locomotive engineers, eliminating much danger and inconvenience.

He has invented two periscopes which can be attached to an ordinary locomotive cab, to enable the engineer to obtain an unobstructed view of the track ahead and of his train in the rear. The periscopes are supported by rubber or other flexible means in brackets, so that they can be readily adjusted in position or turned about a vertical or horizontal axis. The space between the periscope and the roof of the cab is filled with rubber rings.



The telescopic periscope for the engineer's cab is in two parts

One of the periscopes is telescopic and is in two parts held together by a wing-nut and a bolt. It is provided with windows, a removable cover and projections which bear against the securing-clamps. The periscope may be of lazy-tongs type or otherwise adjustable in length, and the mirrors may be protected from smoke by a hood or casing.

So equipped, in an emergency, the engineer is able to see all that is necessary, without leaving his post at the throttle.

One Quick Pressure and the Cork Is Out

THE corkscrew has at last found a rival in the cork-puller, invented by John Sheridan, of San Francisco. Two thin scissors-like blades, having upwardly inclined serrations, are thrust into the cork body. When you close the blade handles, the serrated members open in wedge shape, and the cork can be pulled instantly. The inclined teeth draw the sides of the cork inward, making it smaller than the bottle-mouth, so that it is easily drawn out. The puller can be easily withdrawn by again separating the handles. It leaves only a small hole.

The blades are thrust into the cork, the handles pressed together and the cork extracted

A New Automobile Signal. It is placed on the Left Rear Fender

A NEW signal, mounted on the rear fender of an automobile, flashes a red light by night and a red flag by day, to designate a change of course, with regard to direction. This does away with all the complications of oscillating hands or with the words "right or left", which are sometimes incorrectly manipulated by nervous drivers in emergencies.

The signal consists of a pressed-steel box with a red metal flag on the removable cover and a red bull's eye light at the rear. The device is mounted on the left rear fender and is operated by means of a push button.

In operation, the pushing of a button lights an electric lamp inside the box, and simultaneously energizes a solenoid which automatically causes the red flag on the top of the box to rise from a horizontal to a vertical position, transversely of the car.

The current for operating the signal may be had from a battery. The signal box is weatherproof, to prevent possible short-circuits, although these are further provided against by a fuse block and a ten-ampere fuse placed near the negative pole of the storage battery to prevent the solenoid from burning out.

A push button conveniently located on one of the steering wheel spiders, operates the red flag by day and flashes the red light by night. A battery supplies the necessary current

The chimney conducts the smoke upward and furnishes draft for the flames

Burning the Roots of Stumps Out of the Ground

IN wooded localities, farmers, who wish to remove the timber from their land in order to utilize the ground for raising crops, will appreciate a simple device for burning out the stumps and roots, invented by John H. Hempy, of New Hampshire, Ohio.

The inventor has made ingenious use of the well known fact that draft aids combustion, by constructing a conical chimney of sheet iron in several sections, which is so placed over the ignited stump that a strong draft is created. The air, rushing in from below, by its oxygen aids the process of combustion and keeps the fire burning briskly. After the lower part of the stump is burne away, the upper part settles into the fi and furnishes fuel to burn out the bi roots near the surface.

The lowest section of the cone, with diameter of thirty inches at the botton is made out of heavier sheet iron, whil the two upper cones, which taper to diameter of eight inches, may be made c ordinary stovepipe sheet iron.

The whole chimney is about six fee tall, but may be made higher if a stronge draft is desired.

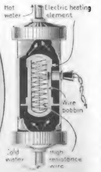
Turn the Switch and You'll Have All the Hot Water You Will Need

FREDERICK POOLE, of Kansas, has invented a water heater which operates electrically. It is even simpler than the gas heater.

An ordinary electric high-resistance heating element is placed in a large cylinder, about a foot in diameter. When water from the small pipe main enters so big a chamber, it travels very slowly. Therefore, when the current is turned through the heating element, the heat from its large radiating surface has an opportunity to make the water hot in so short a time that the method might well be classified as instantaneous.

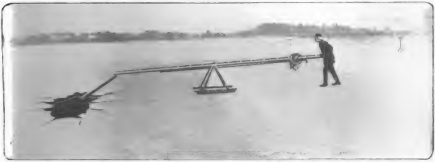
In any home having electricity, but where, without this attachment, it has always been necessary to light the kitchen range, and then to wait an hour or more in order to have hot water; the advantages of this quick method of preparing the morning bath, or, in case of emergency, of obtaining hot water at any hour of the night, will be obvious.

The water slowly passing around the large heating element in the metal cylinder is heated almost instantaneously



A Rescue Ladder for Treacherous Ice

By its use a skater who has fallen through thin ice can be saved without danger to the rescuers



When the cry for help is heard the rescuing apparatus is pushed out until the pole and ladder can be grasped by the skater, who, with its aid is pulled safely to the shore

MAN through the ice! Wherever there is ice skating—and careless, overly venturesome skaters—that cry is sure to rend the air. If these persons are fortunate their calls for help will probably be answered by a rescue party with a rope. But due to the thinness of the ice where it has been broken through, rescue with a rope is a difficult matter and dangerous for the rescuers.

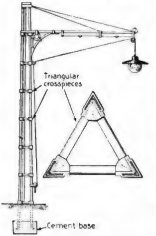
But, with the aid of a new apparatus invented by George Hanlon, foreman in the Department of Parks, of New York city, lying ready for use in an emergency, the chances of fatal consequences of the accident are greatly reduced. The device comprises an ordinary fifteen-foot ladder with a shorter ladder pivoted at one end and a pole mounted under the long ladder to hold the shorter one in place. This outfit is carried on a sled, on which the rescuers haul it to the spot where the skater has gone through. Obviously, the sled can be kept on the thicker ice ten feet away from the hole, while the pole is brought back to release the short ladder so that it drops into the hole. On this the person to be rescued can climb to safety.

If the skater is not able to help himself, however, the big ladder can be [illegible] from the sled and be slid over the [illegible] until it straddles the hole. [illegible] then walk out and with a grappling hook haul out the unfortunate [illegible] on the ladder and draw him to [illegible]

The ladder may be straddled over the hole so that [illegible] on it and locate the bo[illegible] grappling hooks in [illegible]

Make the Collapsible Metal Telegraph Pole an Ornament—Not an Eyesore

AN innovation in telegraph pole construction has been introduced by a Belgian inventor, Oscar Valenne, of New York city. It requires no skilled workmen to erect it, for there are no intricate connections or adjustments to be made. The pole is shipped collapsed into a very small space; but it opens out into a structure of considerable height.



The triangular crossbars hold the telescoping sections of this pole absolutely rigid and upright

Three V-shaped irons are required to form the bodywork. These are held rigid by six triangular crossbars.

The laborers take the three separate V-pieces, run them through the slots at the corners of the largest triangular crossbar, and bury their ends in a block of newly made cement. The crossbar is slid into place, and the smallest one is temporarily placed on top. The top cross bar, or cap, is then removed and, beginning with the largest, the other crossbars are easily slid on.

The Soldier's Cobbler Kit. He Carries It in His Pocket

OUR soldier boys learn many things besides actual soldiering. When they return to their prosaic tasks after the war there will be many a bank clerk, for instance, who will be eligible to join the cobblers' union. Of course there are shoe-repair stations all along the lines of battle, but so much depends upon the condition of his shoes and his consequent foot-comfort, that most of the boys carry the little cobbler's kit shown in the illustration, and make small repairs themselves.

The kit consists primarily of a hollow handle, the top of which unscrews to disclose the awl, screwdriver, cobblers' tacks, and other essentials for repair work. At the opposite end of the device is a spool of waxed twine, which threads immediately into the awl when the awl is screwed into place. When some other tool, such as a screwdriver or knifeblade, is to be used, it is screwed into place instead of the awl. In addition to his shoes the soldier may mend his torn leggings and his saddle traps.

The cobbler kit is used to mend leggings and saddle traps as well as to repair worn shoes

Making Paper and Cord from Marsh Grasses

Thousands of acres of hitherto worthless marshy land can be made to yield millions of dollars' worth of fiber and pulp for various uses

One million acres of this marshy land, overgrown with sedges and grasses, lie south of Savannah, Georgia. It will readily yield from one to two tons of fine dry pulp per acre

WHEN Pharaoh's daughter came across the baby Moses hidden among the bulrushes of the River Nile some three thousand years ago, he was tucked comfortably in a miniature ship made of sedges. In those days the common sedges growing in Egyptian marshes were used for cordage, mattings, sails and curtains, and the ancient vessels of bulrushes were made by binding and sewing them with the filaments of corded sedge.

To-day several large industries are facing a serious shortage in paper pulp, oakum, yarns, twine and kindred products. A decreasing supply of jute from India, sisal from Mexico, and Manila from the Philippines has sent prices skyward, and many manufacturers and publishers have been unable to stand the pinch and have failed. Were the paper and cordage producers as wise as Pharaoh's daughter and would they but go to the marshes for their future supply of raw material, they would find a sufficient quantity of fibers to meet the country's needs. We have been so busy since Pharaoh's time that we have forgotten all about our marsh sedges.

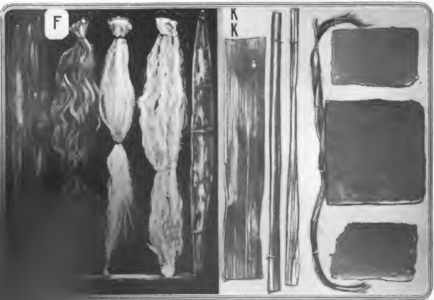
There are thousands—perhaps hundreds of thousands—of acres of marshy land which, from the standpoint of usefulness, might form one of the country's vast natural resources. Consider New Jersey and her marshes, the Virginia and North Carolina swamps and tidal districts, and the innumerable lakes with their fringes of rushes and sedges! If the ancient Egyptians made use of this raw material, why should not we of this age?

Thanks to the thirteen years of study and experimentation made by Col. R. A.

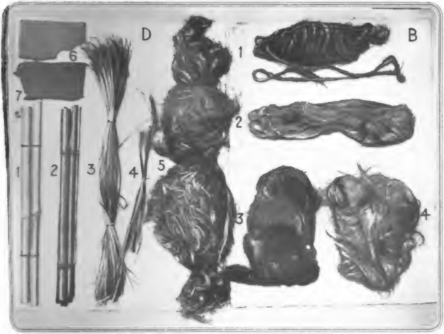
Marr, of Norfolk, Virginia, we are nearer to the utilization of waste areas of swampy ground than ever before. Colonel Marr has taken out patents on a chemical process for the treatment of sedges and grasses which makes them immediately available for industrial use. There are nearly two million tons of wild growth found within the borders of the United States and two hundred and fifty thousand tons within territory contiguous to the United States, which can be chemically treated and made into strong paper and cordage.

There are three hundred thousand tons of an annual growth of fresh and salt water sedges and rushes which can be made into substitute textile fibers for jute and other rope materials. This raw material works easily with jute machinery and it can be used in whole or in part for cotton bagging, light oakums, roofing

Col. R. A. Marr, at left, examining a bundle of oakum made from waste swamp grasses and weeds by his recently patented chemical process



...h bear grass and banana. At left, indicated by F, appears the grass in its ... in its shredded or spinning state, after chemical treatment. In KK is shown ... the making of banana pulp, from the raw article to the finished product



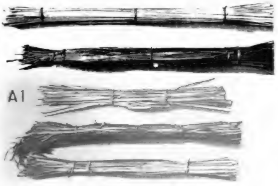
The Different Stages in the Treatment of Reeds and Canes

At left above, indicated by D: 1. Raw cane material. 2. After treatment and ready for rolls and picker. 3. After going through picker. 4. May be used for brush. 5. Bagging for cotton, peanuts, grain and potatoes. 6. Can be used as roofing felt. 7. Fine clean pulp stock. In B above: 1. Bear grass made into cellulose wool. 2. Oakum of good quality. 3. Sedge fiber rove for bagging and pads. 4. Sedge fiber used as plumber's oakum

felts and papers. It is very durable.

Canes, reeds or bamboo, of which there is an annual available supply of five hundred thousand tons, can be used for binder twine, bagging mixtures, coarse sacking, strong cordage, paper pulps, oakums, and strong fibers. Two hundred thousand tons of yucca can be used as a substitute for sisal and Manila and for cordage, twines, yarns, strong papers and paper pulp. There is also an annual supply of two hundred and fifty thousand tons of banana, pita, pineapple and palm which can be utilized for cordage, twines, cellulose, wool weaves, linen and cotton rag pulp.

These



A1 above shows five different kinds of salt and fresh water sedges and rushes which can be made into fiber or pulp. The ancient Egyptians found use for them

plants are wild grown upon waste land and are annually reproduced every six months in some localities. The yield is from one to two tons of dry pulp on an average per acre.

By the processes and methods patented by Col. Marr, the yields of pulp for paper purposes and the yields of fiber for bagging and other cordage are much beyond anything heretofore obtained and recorded. By using either zinc sulphate or chloride, his processes render the gums, resinous matter, wax and fats, the silica and the cementitious carbohydrates soluble in water. In five hours from the raw material to the finished product, oak, beech, birch, maples, gums and poplars yield in available pulp an average of eighty-five per cent of the weight of the wood. It is not necessary to chop wood as fine for reduction by his processes as with processes now in use.

To possess commercial value a fiber must be available in large quantity, the supply must be more or less constant, the product must be readily marketed, and it must be cheap. The fibers obtained from marsh growths, by the processes patented by Col. Marr, fulfill all these requirements.

What Is It? A Naval Architectural Puzzle

AT the Water Sports Carnival held annually at Copenhagen, Denmark, any inventor can demonstrate his devices, provided they are in tangible shape and have something to do with sport or locomotion in water. The contests are usually staged on Sortedamsöen.

In the scene shown, the catamaran with a rear paddlewheel, at the right, is an old contraption dating back to the first bicycle days. The similar craft to the left, is fitted with a heavy keel to steady it, and the float is hollow and very shallow. It obeys the rudder better than the catamaran. Mystery centers in the queer tub in the middle with its ambitious streamline contours and its electric wires dangling at the side. Its wake does not indicate great speed, and the flag does not seem to unfurl in the breeze. It appears that the pilot has storage batteries on board and that he is driving two motors in watertight compartments in the pontoon, which motors, in turn, drive two Archimedian screws or similar contrivances to take in water and to expel it.

...y good mechanics who think more of having fun in some new way with ... of making money by exploiting their inventiveness commercially

What's in a Name? In "German Silver," for Instance

GERMAN silver is manufactured in three general ways. It is composed of nickel, copper and zinc in varying proportions. The German method is to melt all the copper to be used in the mixture, and two-thirds of the nickel and zinc in a graphite crucible and then add the rest of the nickel and zinc. In the English method the copper, nickel and zinc are melted all at one time, then more copper and zinc are added. Should the metal appear porous, a fireclay pipe containing pitch is pushed into the metal mixture to deoxidize it. There are several American methods. One is to melt a copper-nickel alloy and then gradually add the preheated zinc. In another method monel metal is used as a base.

Business is good, thank you, in this the narrowest of stores. Can you see the store?

You Can Attach This Humidifier to Your Radiator

A HUMIDIFIER is now manufactured which may be quickly attached to a flat or round top steam radiator. Two soft pliable wires are passed between the radiator coils to the back of the humidifier, where they are tightly wound round two buttons. This enables the moistening device to be attached as firmly as if it formed part of the radiator. When it is desired to remove the water from the humidifier it is only necessary to unloosen the wires from the buttons, then the device can be carried to another room for cleaning. When the radiator is not being used during the summer months, the water in the humidifier may be removed and the box-life part be utilized as a temporary resting place for flowers until they can be planted.

The humidifier is made fast to the radiator by two wires passing between the hot-water coils

The Narrowest Store. It Is Only Six Feet Wide

GROUND space must be extremely valuable in Corry, Pa., judging from the manner in which the owner of a six-foot strip between the right of way of a railroad and the building line of one of the streets of Corry utilized his property. He erected a brick building, six feet wide and about seventy-five feet long, and installed in the narrow building a lunch room at one end, and a cigar, candy and ice cream counter at the other. The queer structure caused considerable amusement at first, but it proved a good investment. When the railroad encroached about two feet upon the ground, it had to move back.

The Camera Gun: Photograph Your Bird Before You Shoot Him

THE expression, "take a snap shot," [illegible] real to the photographer [illegible] a new camera support [illegible] invented by George [illegible]. The support is made in the form of a gun. The camera is attached to the barrel in such a manner that in sighting the object to be photographed [illegible] the exposure is made by pulling a trigger.

The camera may be attached to a real gun instead of to the support which looks like one. This arrangement will enable a hunter to photograph [illegible]

[illegible]

sufficiently fine they curl and fluff ou[illegible] like wool.

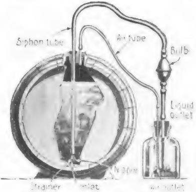
The product is now marketed in thre[illegible] forms: glass cotton, glass wool, and i[illegible] sheets about one-half inch thick whic[illegible] resemble white felt pads. In the las[illegible] form [illegible] may be use[illegible] to make se[illegible] [illegible]

The Sucker [illegible]—Sh[illegible]

[illegible]

A Sausage Dealer Out-Pigs the Pig in Hungry Berlin

HAVING tried a substitute for almost everything, the Germans, we are told, are stopping short of nothing in their attempt to make certain new foods take the place of those made scarce by the war. The latest report says that a sausage dealer in Berlin has been fined $500 for selling sausage made of macerated rubber, finely ground hair and gelatin. His camouflage product contained no liver, no flesh foods and no fats. At that, it was probably as digestible as some so-called sausage on sale in this country.

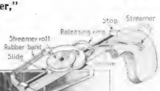


The stream of liquid is siphoned from one bottle to another by pressure on the rubber bulb

Shoot Your Streamers with a Gun and Save Your Arm

A WOODEN gun, with a stock and barrel not unlike the first archer's pieces ever used, but withal an improvement on the schoolboy's "bean shooter," has been invented by Jose L. Castillo, of San Francisco, California, for hurling long streamers or serpentines over the heads of people at carnivals and outdoor festivals. Elastic bands take the place of gunpowder and the barrel is nothing more than a slide, traveling in a groove. To shoot the streamer, you place it against the slide and fasten the hook or trigger over a stop, which takes the place of a trigger. Elastic bands afford the tension and the instant the hook is released the slide with its streamer shoots forward, the slide striking a forward stop and the streamer continuing on until it breaks. Before firing, the streamer is fastened to a clip on the stock.

It is well to unwind the streamer a few inches before it is fired, to prevent it from breaking off short.



Every streamer would sail far and swiftly if expelled from a gun

Making the Siphon Empty Heavy Bottles

IN factories where large amounts of liquids are handled, the siphon, devised by Charles Barrow and John Karpen, of Racine, Wisconsin, will be appreciated because it does away with the lifting of heavy bottles.

With his siphon, the chemist inserts the ends of two tubes into the large bottle and places the other ends into the bottle to be filled. One tube contains a large rubber bulb. The second tube contains only air.

When the bulb is rapidly compressed, the pressure on the top of the liquid in the end of the tube is reduced. The greater pressure on the top of the liquid outside of the tube forces it toward the inside, then up and into the smaller flask.

The Camera-Gun. Photograph Your Bird Before You Shoot Him

THE expression, "take a snap-shot," becomes very real to the photographer who uses a new camera support recently invented by George Lansis. The support is made in the form of a gun. The camera is attached to the barrel in such a manner that in sighting the object to be photographed, just as a target is sighted with a rifle, the exposure is made by pulling a trigger.

The camera may be attached to a real gun instead of to the support which looks like one. This arrangement will enable a hunter to photograph any bird or animal just before it falls a victim to his gun. Or, if the camera is equipped with a quick-action lens, the bird might be photographed at the instant it is shot, to test the hunter's accuracy.

With this device naturalists could obtain a photograph of the animal and the animal itself within the space of a few seconds.

The camera may be attached to a real or dummy gun

The Wigs of the Future May Be Made of Glass

IN Venice they are spinning glass for commercial uses, converting it into glass cotton and glass wool pressed into sheets or pads. Although the principal use of the product at present, is for insulation, we have the word of the Italian makers, that it serves admirably for making artificial hair, wigs, perukes, doll's hair, Santa Claus beards and other hirsute adornments. The processes of manufacture are simple. Solid glass rods, made of pure American soda that contains no adulteration of lead or other metal, are worked into fluff under a Bunsen burner and blowpipe. A bicycle wheel, minus the tire, winds up the threads. If the threads are sufficiently fine they curl and fluff out like wool.

The product is now marketed in three forms—glass cotton, glass wool, and in sheets about one-half inch thick which resemble white felt pads. In the last form mentioned, it may be used to make separators for accumulators of electricity.

The Slacker Hen—She Lays Curious but Uneatable Eggs

THERE is only one thing to do for the hen who lays such eggs as the freak formation shown in the accompanying photograph. It is a case for the application of the verdict rendered in the old college song, "Chop Her Head Off—Short!"

The freak has two decided curves and at first glance looks almost like a snail. It was laid in the same nest in which a dozen or more small eggs, like birds' eggs, had been found during the spring and summer. These tiny eggs contained no yolks at all. It is probable that the curiously formed egg shown here is also yolkless.

There are two reasons for passing the death sentence upon the hen that laid the egg. One is that slackers in the poultry yard during war-time are not to be tolerated under any circumstances; the other is that the hen is unhealthy and is probably suffering from some internal disturbance.

The freak egg placed beside an egg of natural size and shape for the sake of comparison

A Sausage Dealer Out-Pigs the Pig in Hungry Berlin

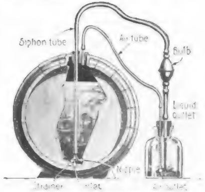
HAVING tried a substitute for almost everything, the Germans, we are told, are stopping short of nothing in their attempt to make certain new foods take the place of those made scarce by the war. The latest report says that a sausage dealer in Berlin has been fined $500 for selling sausage made of macerated rubber, finely ground hair and gelatin. His camouflage product contained no liver, no flesh foods and no fats. At that, it was probably as digestible as some so-called sausage on sale in this country.

Shoot Your Streamers with a Gun and Save Your Arm

A WOODEN gun, with a stock and barrel not unlike the first archer's pieces ever used, but withal an improvement on the schoolboy's "bean shooter," has been invented by Jose L. Castillo, of San Francisco, California, for hurling long streamers or serpentines over the heads of people at carnivals and outdoor festivals. Elastic bands take the place of gunpowder and the barrel is nothing more than a slide, traveling in a groove. To shoot the streamer, you place it against the slide and fasten the hook or trigger over a stop, which takes the place of a trigger. Elastic bands afford the tension and the instant the hook is released the slide with its streamer shoots forward, the slide striking a forward stop and the streamer continuing on until it breaks. Before firing, the streamer is fastened to a clip on the stock.

It is well to unwind the streamer a few inches before it is fired, to prevent it from breaking off short.

Every streamer would sail far and swiftly if expelled from a gun



The stream of liquid is siphoned from one bottle to another by pressure on the rubber bulb

Making the Siphon Empty Heavy Bottles

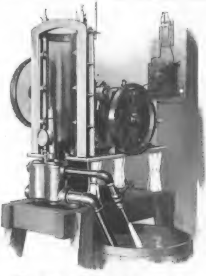
IN factories where large amounts of liquids are handled, the siphon, devised by Charles Barrow and John Karpen, of Racine, Wisconsin, will be appreciated because it does away with the lifting of heavy bottles.

With his siphon, the chemist inserts the ends of two tubes into the large bottle and places the other ends into the bottle to be filled. One tube contains a large rubber bulb. The second tube contains only air.

When the bulb is rapidly compressed, the pressure on the top of the liquid in the end of the tube is reduced. The greater pressure on the top of the liquid outside of the tube forces it toward the inside, then up and into the smaller flask.

How a Photograph Can Show the Efficiency of a Pumping Machine

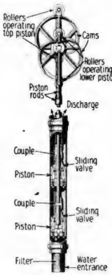
ONE of the finest demonstrations of correct mechanical principles in a machine is given in the accompanying illustration. Although the pump and motor are on a precarious mounting of eight glass tumblers, and although the outfit is pumping away at full speed, a photograph of eight minutes exposure failed to detect the slightest vibration. To the experienced engineer, one look at the picture would convince him of the pump's high efficiency.



The almost entire lack of vibration or jar is a good indication that this non-pulsating pump has a wonderfully high efficiency

And that is what the manufacturers wanted to show. The pump, which is non-pulsating, has been designed on a new mechanical basis. High speed pumps that are seen nowadays are crank driven. A crank drives the pump pistons fast at the middle of the stroke, and then slows them down at the end. The result is a violently pulsating stream, the reaction of which, especially if the water is pumped to any height, is enough seriously to jar the pump.

As shown at the right, it has two pistons in the same cylinder, so reciprocated by cams on the pump frame work that a solid, uniform flow is produced. One piston sucks and lifts the water at constant speed during the larger part of its pumping stroke. Over the remainder of its stroke, the same piston gradually trails the load off while the other piston is assuming it. The combined flow is thus always uniform and equal to the rated amount.

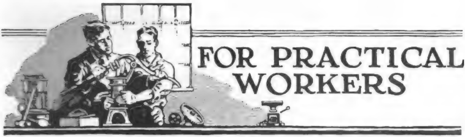


The principal parts of the pump and their relation to one another

The continual stopping and starting of the column of water, which causes a great waste of power and which is hard on the machinery, is thus replaced by a uniform stream which doesn't as much as knock over the lead pencil at the top of the machine. Compared with other pumps, the one described here is said to effect a saving of eighty per cent of power and fuel.

There Has Been a Shortage of Coal in Italy Ever Since 1913

ITALY is so pressed for coal that gas engineers are compelled to employ substitutes. Since the war with Turkey, in 1913, there has been a serious shortage of fuel in the country. Today, coal costs seven times as much as it did a few years ago. Yet, strange to say, the price of coke has not risen in proportion to coal. At the middle of 1916, coke was costing but two and a half times as much as before the war. Private gas works, which have made pre-war contracts with the municipal authorities, are in a precarious condition and are running at enormous losses, due to the exorbitant prices they are obliged to pay.

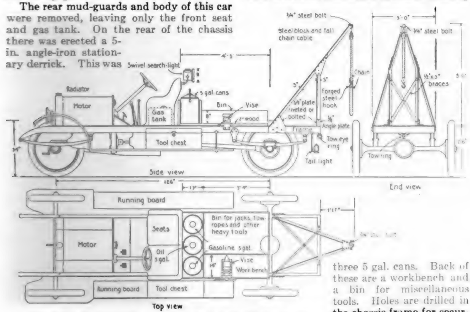


FOR PRACTICAL WORKERS

Making an Automobile Serve as a Wrecker

IT is almost a necessity for every garage to have a road repair automobile, and one with a lifting crane is most desirable. The one illustrated was built from an old discarded pleasure car, having a 40-horsepower engine and a three-speed sliding gear with a leather cone clutch. Generally an old car is best for the purpose, providing it is mechanically good.

The rear mud-guards and body of this car were removed, leaving only the front seat and gas tank. On the rear of the chassis there was erected a 5-in. angle-iron stationary derrick. This was reinforced and the derrick was held to the chassis frame with $\frac{3}{8}$-in. plates. A forged steel eyelet having a 2-in. inside diameter hole was attached to the upper end of the angle-iron with rivets. To the eyelet was hung a hoisting block and tackle, the lower member being equipped with a 3-in. forged steel hook. This is for the purpose of raising the axles and frame of the broken automobile sufficiently to quickly assemble new parts. Back of the automobile seat is fitted a 2-in. oak platform 4 ft. 5 in. long and having a width the same as the original body. On top of this platform are built 8-in. compartments with reinforced iron corner braces for holding three 5 gal. cans. Back of these are a workbench and a bin for miscellaneous tools. Holes are drilled in the chassis frame for securing a heavy 6-in. vise, which is a very necessary tool for a road repair bench.



Details of the framework for a crane to be attached to the rear end of a chassis frame and workbench to make a wrecking truck

Attached to the extreme end of the chassis frame is a ½ by 1¼ clamp through which is

placed a 3-in. forged steel ring for towing purposes. From the lighting system of the automobile an 8-in. swiveled head lamp was attached to the rear of the seat. Whether electricity or acetylene gas is used this arrangement serves the purpose excellently when making night repairs. The lamp may be turned directly on the work.

A large tool box is built on the left running board. In this all necessary bench tools are carried, including hammers, wrenches, files, hacksaws, hand drills, gasoline torch and soldering outfit, a set of dry batteries, wire tape and assortment of bolts, nuts and washers, from 1/2 to 6-in. tire repair outfit, gasoline priming can, spark plug kit, etc. Back of the seat a tarpaulin is kept. A small emery wheel grinder may be geared from the flywheel by a friction pulley and a 3/8-in. countershaft run parallel with the frame to the workbench.—P. P. AVERY.

A Liquid to Clean Silverware Without Damage

WHEN using silver polishes, it should be remembered that some silver is always removed in the cleaning process. For this reason liquid polish is sometimes preferred to the ordinary powder, as it removes the tarnish without scratching, and at the same time leaves a bright lustre. A very satisfactory liquid polish can be prepared by mixing five parts of aqua ammonia, [illegible] parts sodium hyposulphite, and ten parts of ammonium chloride in 200 parts of water. The greatest distributor of silverware in New York city recommends the use of sodium hyposulphite in water.

A Guard to Prevent You from Dipping Your Pen Too Deep in the Ink

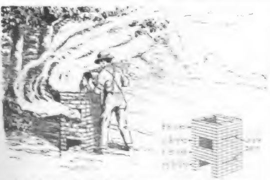
CUT out a small square or circle of mica and slip it over your favorite penholder about 1/4 in. from the pen point. A small brad on each side will hold the mica extension in place. This arrangement will serve as an excellent ink gage when dipping the point in the bottle and also as a guard against ink stains. The mica square will prevent the pen from being dipped in too far. It does not obstruct your view of the writing; you can see through the mica. Should it become stained, washing it in a little water will immediately clear it. —CLARENCE T. HUBBARD.

A square of mica protects your fingers from ink stains

An Easily Constructed Brick Incinerator for Garbage

AN effective, cheap incinerator for a suburban home can be made from the materials listed herein. First lay six and one-half bricks on a smooth base, beginning on one side with half a brick placed next to a whole brick; then take a whole brick and lay it crossing the end of the last one. Continue this until the full six and one-half bricks have been used.

The second, third and fourth rows are laid in the same manner, lapping the joints. When the fourth tier is completed lay on a good 1/2-in. coat of mortar and imbed in it ten iron bars each 21 in. long and about 1/4 in. in diameter (or the flat kind) laying two in front over the bricks to support the next tier, spacing them equally. Another complete tier of eight bricks is then laid, starting with six and one-half



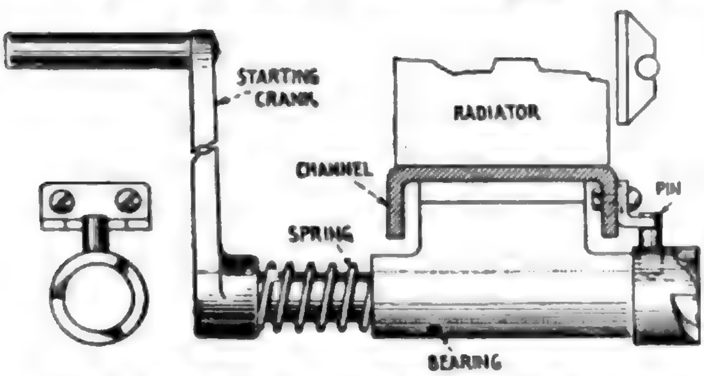
An incinerator built of a few bricks, having a grate under the garbage grate for drying and burning the refuse matter

bricks to make the front opening. On top of this lay ten more bars imbedded in the mortar, then lay five layers of brick, finishing the top by rounding it off with mortar.

When this is completed the incinerator will have a fire grate below and another grate above entirely surrounded with bricks. The second grate forms a receptacle for garbage. The mortar should be made of slacked lime and sharp sand.—RONALD F. RIBLET.

Holder for the Starting Crank of an Automobile

ON some older types of automobiles no provision was made for securing the starting crank when it was disengaged. The



The pin on the jaw-clutch that slips into a notch for holding crank in an upright position

arrangement shown herewith for holding the starting crank is easy to make and apply and will be found very effective. The sketch shows the usual jaw-clutch shaft held in a bearing fastened to the underside of the radiator channel.

The crank-holding device consists of a hardened steel pin driven in the large part of the clutch shaft so that it will engage the slot plate when the spring forces the shaft outward. When cranking the motor the pin clears the slot plate. The pin is either a drive fit in the clutch shaft or is threaded. If the shaft is hardened it will be necessary to anneal it before trying to drill the holes.—W. BURR BENNETT.

Cut Your Ice Silently and Easily With a Needle and Thimble

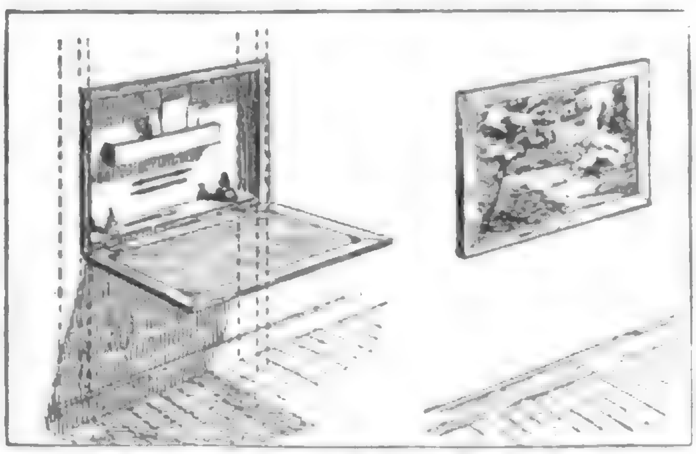
A BLOCK of ice can be split into small pieces in a very short time by the use of a needle and thimble, without the trouble of putting the ice in a bag and pounding it or the muss attending the shaving or picking process.

A rather coarse needle of the variety used for hand sewing, or a small darning needle, and a thimble are the only tools required.

Hold the needle between the thumb and index finger of the right hand, and with the thimble on the second finger of the same hand press the needle firmly and steadily into the ice. In a second or two the piece of ice of the size desired will quietly crack off. This method has its silence to recommend it.—C. B WHITEHOUSE.

A Built-In Writing Desk Made from a Bread Board

WHEREVER a compact writing desk is needed this type can be used to advantage, especially in the summer cottage. The desk itself is nothing more than a flat board. A bread board 16 by 22 in. would be about as satisfactory as anything. First decide on the location. If, as in a summer camp, there is no plaster and the studs are exposed, the position of the desk may be between two of the studs. If there is plaster, it will have to be broken through between two studs. About 30 in. above the floor and between the studs nail another piece the same size as the studs like a header. From this cross-piece hinge the bread board as shown in the illustration and fasten it to a chain on one side to hold it in a horizontal position when it is down. On the inside of the desk top fasten a blotter, and adorn the outside with a picture. The studs are usually spaced about 18 in. on



The built-in writing desk as it appears when it is open and closed

centers so that a clear space of about 16 in. will be in the wall between them. The back of this may be used as a space for a rack for papers and hooks for pens and pencils and place for ink, etc. The illustration furnishes a suggestion as to what can be done and how the desk looks when it is closed and out of the way.—HAROLD V. WALSH.

A Completely Equipped Portable Cabinet for the Photographer

THE case shown is 24 in. high, 30 in. long and 6 in. thick. It may, of course, be made any size, but this one can be placed behind a door or in a closet out of the way, and is large enough so that the printing box compartment will accommodate a 5 by 7-in. size or smaller. The capacity of the case is surprising. On the upper left door are the scales, which can be tilted to bring them level, a dropping glass, stirring rod, palette and tweezers. On the upper half are eight 4 by 5-in. holders and an exposure meter. On the upper center shelf is room for all sorts of sensitized paper up to 12 by 14 in. in size for enlarging, and the latest negatives. On the right side the shelves occupy only half the width, the remainder being placed on the door.

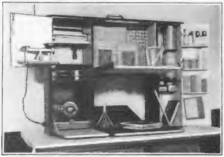
The cabinet when closed can be carried easily

In the case will be found 1 lb. of sodium carbonate, ½ lb. of sodium sulphite, 1 oz. potassium metal-bisul[illegible], 1 bottle retouching varnish, two bottles of toner, 1 box of potas[illegible]trate, 1 box potassium bromide, [illegible] of copper sulphate, 1 box pow[illegible]lum, 1 box citric acid, 1 box [illegible] alum, and 1 glass funnel. In [illegible]tom section is a book of for[illegible]. On the door is 1 bottle each of [illegible]cent bromide of potassium, pyro, and amidol, 1 box hydroquinone, [illegible] potassium ferricyanide, a pack of [illegible]aper, 1 box of opaque, 1 box of [illegible]ner, 1 box of green toner, 1 box [illegible]ifier and a rack for masks at the [illegible]

[illegible] the two doors shown in the lower central portion are closed, the trays, trimming board and blotting pad may be stored therein. When these doors are lowered they at once become available for holding the various trays in development. The door in the foreground is covered with rubber. The lower central portion is also provided with a folding rack for glass plates and with clips for holding films while drying, which keeps them out of the dust.

At the lower left is the printing box, the inside of which is painted red and provided with a curtain of ruby fabric, shown partly raised from the bottom. This runs in grooves and is held up at the top by a spring, thus closing out all white light, making a fine dark lantern.

What appear to be two narrow drawers above the lamp is the printing frame, the lower half slides out only half way and the top part the rest of the way, so that a negative may be inserted and removed easily. The red light reflected from the white enamel door below, throwing the rays up through the negative, makes placing the paper an easy matter. The corner shown partly raised is fastened to the frame so that when the frame is pushed back in the case it is forced down in close contact with the paper and negative by two flat



The cabinet opened showing the compartments for the chemicals, plates and papers

springs placed beneath the compartment housing the scales. This door is also provided with a spring to open it, as shown, as it is withdrawn from the case. This, of course, stops the printing.

The lamp shown is for enlarging; the one for printing is back of the curtain

where the wire enters. The curtain, when released, rolls down out of the way, being actuated by a spring such as used on window shades. Inside the central portion is a switch for shifting the current from one light to the other. The brass corners and handle were purchased. The case was painted inside and out as a finish.—I. E. PETTIBONE.

A Homemade Sawdust-Burning Heating or Cook Stove

HERE is a little new-style stove which will save your coal. It burns sawdust. You can make the stove yourself if you are handy with tools. It is simply a cylindrical box made of sheet iron, about 7¾ in. in diameter and eight inches deep. It has no lid. The box should be filled with sawdust to within an inch of the top, leaving the rim, which is pierced with eight holes ¾ in. in diameter, uncovered. Three small pieces of sheet iron, bent at right angles and riveted inside below the top, serve as brackets to support the cooking utensil at the right height above the flame.

Before filling the box with the sawdust, a piece of wood 10½ in. long, tapering from 1¾ in. in diameter at one end to 1¼ in. at the other, is placed, small end downward, in a vertical position at the bottom of the box. Another piece of wood 1¼ in. in diameter and 6 in. in length is inserted through a hole in the side, at the level of the bottom. One end of this piece is slightly hollowed to fit the lower end of the vertical piece. These two pieces of wood act as a kind of core around which the sawdust is packed and rammed down hard with a wood rammer. After the sawdust is packed in, the pieces of wood should be removed, leaving two holes, one vertical and the other horizontal. Through the vertical hole a few drops of kerosene are poured, and through the horizontal opening a lighted taper is inserted. As soon as the sawdust catches the blaze, the cooking utensil may be placed over the top. The fire will burn from three to six hours without replenishing and without flaring up. It gives off a good heat, sufficient for any kind of cooking or for laundry work.—JAMES A. CARTER.

The Animated Match Box on the Back of the Hand

DO this trick before a mirror and you will actually surprise yourself. Although exceedingly simple it is very perplexing to the onlooker. Take an ordinary match box and lay it flat on the back of your hand. At your command it will "sit up" or "lie down." Moreover, it will accomplish the task slowly or rapidly at your own will. No threads, wires, wax or weights are used. Nothing but your hand and the match box. Try it as you read this.

The skin on the hand is gripped in the box

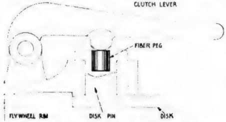
When placing the box on the back of your hand have the drawer open just the slightest bit. Push it together with the fingers of the hand that is placing the box. This will cause a bit of the loose skin to catch in. The box will lie perfectly flat until you push your closed up fingers into your palm. The slightest strain will tighten the skin and the little box full of matches will gradually rise up in the most amusing manner. To have it "lie down" merely relax the pressure. As you do this not a muscle or vein will move. Only the slight "pinch feeling" of the skin will keep you from fooling yourself.

Tire Damage Caused by Driving in Street Car Tracks

ROUGH streets tempt one to drive in car tracks. It is more comfortable for the passengers and may seem more of an economy to protect the car on special occasions from bumps and unusual vibration by running in car tracks, rather than over rough, cobblestone pavements. The tires will not be injured by doing this occasionally; however, to continue the bad practice shortens the mileage of the tire. Quite often the pavement along the inside edges of the rails is very rough and may result in cuts to the rubber and bruises to the fabric. Driving over street car track switches, the pointed frogs may cut the tires beyond repair.

Inserting Hard Fiber Plugs into Automobile Clutches

THE studs that disengage the dry plate clutch of a certain make of automobile are made of a softer material than the disengaging levers. This causes the plugs to



A fiber plug to take the place of a worn-out steel stud in an automobile clutch

wear rapidly, necessitating the replacing of them frequently.

To avoid the expense of purchasing new studs, we inserted hard fiber plugs to put the stud into proper condition again. These plugs were inserted into tapped holes, and when removing an old one it was merely necessary to drill out the larger portion and then force the balance out by running a tap through the threads.—ADOLPH KLEIN.

A Loose-Leaf File in Which to Keep Photographic Films

THE filing case is made of a loose-leaf note-book, of a kind having the leaves held at one of the narrow edges, and in which they are as large as the films that are to be preserved. Holes that correspond in size and location with those in the leaves of the note-book should be punched into the margins of the films. The printing quality of the negatives suffers no injury from this operation, as the margins are blank.

Into the binder are inserted alternately a loose leaf and a film. On the face of each loose leaf may be written a complete [illegible] of the following film. By this [illegible] each film is separated from [illegible] is well protected. [illegible] beginning of [illegible] which an index [illegible] the leaves [illegible] located.

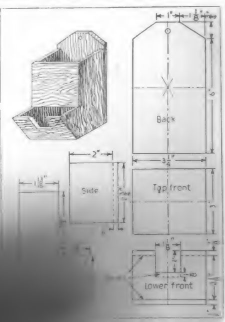
Where a [illegible] preserved [illegible] them in separate binders, sorting them according to their descriptions, such as portraits, landscapes, etc.

When any film is removed for printing its accompanying record leaf should also be removed, to prevent the two from becoming separated.—F. M. WAGNER.

An Automatic Match Safe for Holding Box Matches

A VERY useful match safe can be made from any ordinary ¼-in. wood. It is convenient because after the cover is taken from a match box it can be slid right into the safe, and also, because it can be hung on the wall as well as set on a table or shelf.

The dimensions on the accompanying illustrations are for ¼-in. stock and they should be slightly changed if the wood is of any other thickness. The accompanying illustrations show the construction of the safe as well as the dimensions.



[illegible]tch safe to hold a [illegible] to deliver them a [illegible] bottom of the box

[illegible]r is wanted on the safe, [illegible] may be glued to the top [illegible]E MCCOTTER.

A Simple Method of Securely Fastening Umbrella Handles

IT frequently happens that an umbrella having an expensive handle will get broken. The owner may naturally desire to have the handle put on another umbrella. By following these instructions any person can make the change of handles.

Clean out the hole in the handle, then wrap a few layers of cloth on it and clamp it in a vise, using just sufficient force to the jaws to hold it upright. Then put powdered sulphur in the hole—heat the end of the umbrella rod red-hot and push it down in the sulphur. The heat will fuse the sulphur and cause it to grip the rod tightly. This method can also be used to fasten rods into stone, iron or wood.—W. S. STANDIFORD.

Inserting Manifold Papers Evenly in a Typewriter

THE insertion of manifold papers is a job which taxes the patience of many who have occasion to use the typewriter. It is difficult to keep the papers "squared." The difficulty may be overcome by folding a narrow strip of paper, placing it over the top of the sheets, and then inserting them in the machine. This keeps the sheets in the desired position.

Laying Out and Finishing a Plain Blanking Die

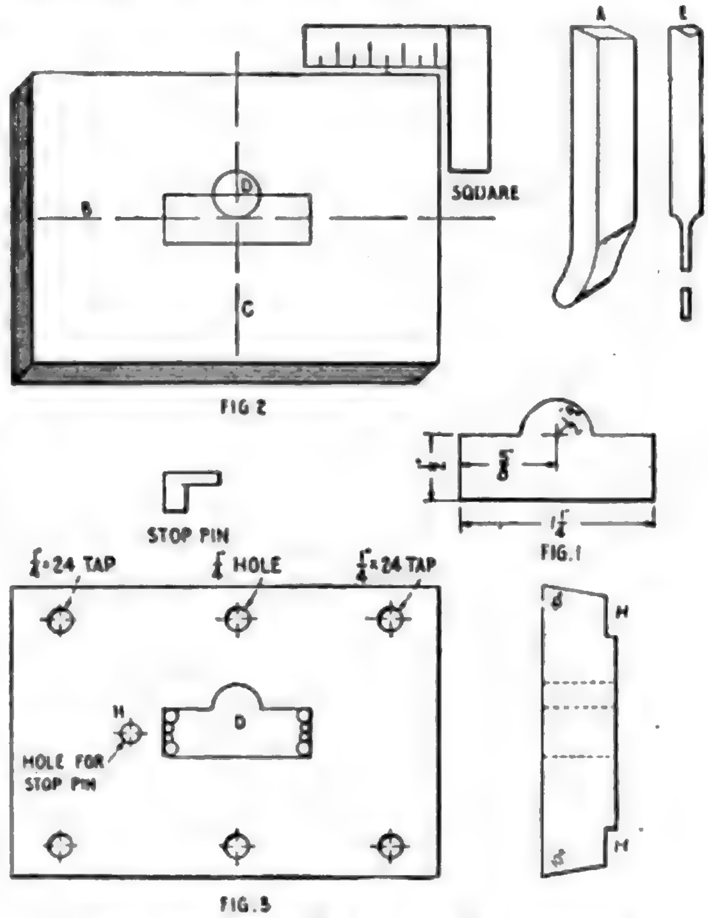
THERE are numbers of good machinists who, with a little instruction, could qualify as tool and die makers, for whom there is great demand. The following article deals with a very simple die, but it gives some idea of the fundamental rules so that a lathe man who masters the instructions given will not be entirely inexperienced when called on to do this work.

We will assume that a die is required to blank some pieces of No. 20-gage hard sheet brass, and the dimensions called for are as given in Fig. 1. The tools necessary for this layout are the square, dividers and scriber. The steel for the die is placed in the shaper, and unless the sides are unusually rough, a cut is taken on the piece to be used for the bottom. After this is done the piece is reversed and the top is planed off and smoothed with a tool, as shown at *A*. Again clamp the piece in the planer and trim off the four sides, taking care to make them as square as possible. This will be a great aid in laying out the more complicated die work. It is very necessary to have a bottle of blue stone solution at hand, which when applied to the surface of the steel will produce a copper-colored coating for taking the lines that are drawn thereon for the work.

After the blue stone has been applied, scribe the center lines *B*-*C* Fig. 2; then the lines ¼-in. on each side of the line *B;* draw the intersecting lines at the end, always measuring from the center. The radius of projection is ½ in. and is measured with the dividers, taking for a center the point on the line *C* at *D*. The die is now laid out.

For drilling the core, a line is drawn on the inside as in Fig. 3, on which there are spaced the punch marks so that a drill will not quite touch the outline when drilling the holes. This spacing should be as close as possible so that the core can be easily removed.

Before the holes are drilled, the die is strapped to the face plate of a lathe, and

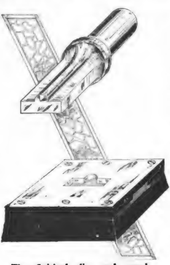


Shape and size of the piece to be punched, details of making the die and tools used

after centering it on *D* it is drilled and reamed to size. The clearance for the passing of the blank at this point can be made by adjusting the compound rest on the lathe carriage, instead of filing the die after-

wards. When this is done the die is removed and the core drilled out. A flat chisel as shown at E is necessary to break the web left from the drilling of the core. Do not drill the holes too close to the die line, for a cut over the outline will make it necessary to use a putting-on tool. It is easier to remove the stock by filing than to hammer the steel to fill the space.

The die being small it is not necessary to use a milling machine for finishing. The finishing is done by chiseling off most of the web and then filing to the lines. When this point is reached and the proper clearance is made, the die is again placed in the shaper and a cut taken on both sides of the die as at F. This is to make the clamp hold and to prevent the die from lifting out of the bolster. In case of mishaps necessitating regrinding, the die should be cut away as at G, which saves time. A depth of 1/8 in. is sufficient. Four holes are now drilled and tapped as shown for 1/4-in. screws having 24 threads to the inch. Two holes are also drilled for dowel pins.



The finished die and punch ready for the power press

Do not forget that there must be a stop for the material after it is blanked. For this purpose a hole is drilled at H and a pin driven in and bent over.

Die makers are not always permitted to do their own hardening, but should this be a

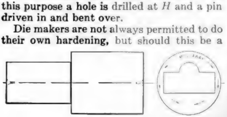


FIG 4 END VIEW OF PUNCH

Plan of the punch and manner of cutting the metal away to make the proper shape

part of your work proceed as follows: Fill up the drilled holes with fire clay to prevent any possible stresses or cracking. After ascertaining what kind of steel you ha[illegible] and the treatment required, heat i[illegible] the proper temperature, or color, and quench it quickly in water or oil. After hardening the surface of the die, clean it and replace it in the furnace to bring it to a dark straw color, or 460 deg. F. The die is now ready for use in making the punch, which is shaped from a round piece of steel 1 1/2 in. in diameter. A piece of the steel is cut to the right length; the ends are centered, put in a lathe and turned down, as shown in Fig. 4, to the size necessary to fit the punch holder for the press work. When this is done, brighten the large end and apply the blue stone solution; clamp the end in a vise and lay the die upon it. Transfer the outline of the die with the scriber.

Next, take the piece to the milling machine and clamp it in the chuck of the index head or between centers. Mill all around and up close to the line scribed, as shown in the end view. Then remove it from the chuck and file it so that the punch will just about enter the die; now adjust it in the press as if for use with the already made and hardened die, and "shear it." Care must be taken to see that the die will remove some metal from all sides. When located properly, force the punch into the die. If too much material has been left on the punch, do not attempt to force it through, but remove again and file to mark obtained by this operation. To insure a good smooth finish as little material as possible should be left to shear.

The punch is hardened in the same ma[illegible] as the die and the cutting edge [illegible] sharp. To complete the [illegible] make the stripper pl[illegible] steel of about [illegible] 5, is clamp[illegible] coincide [illegible] plate [illegible] bla[illegible]

the setting is correct the stripper is fastened to the die and the punch is forced through. It is not necessary to force the punch entirely through, as a part must be milled out

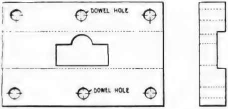


FIG. 5

Stripper plate to prevent the stock from sticking to the punch when it is drawn

for the brass stock to pass through. For this die the material will be $\frac{7}{8}$ in. wide and the stripper milled to a depth of $\frac{1}{4}$ in.

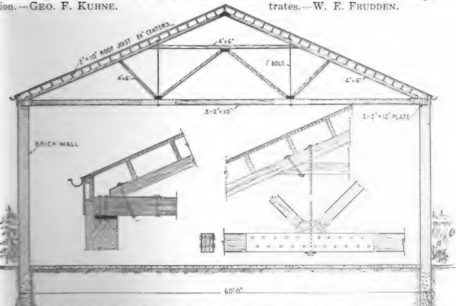
After removing all sharp edges from the stripper, the hole for the punch should be filed slightly to provide a sliding fit. When assembled on the power press a strip of brass is run through the opening, as the press is operated, and blanks are made at each stroke to the shape and size shown in the illustration.—GEO. F. KUHNE.

A Self-Supporting Roof for a Small Public Garage

IN rural districts many contractors are being confronted with the problem of building public garages without the troublesome posts to support the roof girders. The garage with posts here and there over the floor area is of little value. The plan here illustrated shows how an economical truss can be built of wood so that the roof can be supported without posts. This design is practical for garages as wide as 60 ft. and is built up entirely of wood timbers and 1-in. rods that can be purchased from any country lumber dealer's stock.

The lower member is built up of three 2 by 10-in. planks spiked together with joints staggered so that no two end butt-joints will be at the same place in the girder.

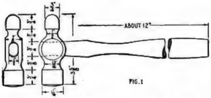
All the upper part of the main truss, is made of 4 by 6-in. stock, cut according to the pattern with 1-in. rods as ties, and double nuts at the bottom for tightening. The strap iron at the end of the truss is the main part. Any carpenter with ordinary skill can erect this design satisfactorily. Finish up with a neat cornice as the drawing illustrates.—W. E. FRUDDEN.



Supporting roof girders with a trussed frame having a lower member built up of three boards to make the length, all of which are spiked together with staggered joints. This provides a wide covering without supporting posts

Simple Designs for Hand-Made Mechanic's Tools

ONE of the first tools selected by the mechanic when collecting a personal outfit is the hammer, and the work which he intends to do decides one of the most important factors in hammer con-

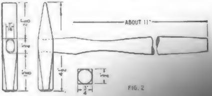


Design for a ball-peen hammer weighing seven ounces, forged or cut from bar stock

struction,—that of weight. While hammers can be purchased at a reasonable price, they, as well as other tools, can be hand-made. Such, when properly designed, are highly prized by the owner.

While working at the mechanic's trade I constructed in my spare time a number of tools, and to this day no other tools purchased seem to be so satisfactory or to fit the hand so well as those made by my hand. In making these tools only limited facilities were accessible such as any amateur may find available in almost any locality.

The hammer is the most used tool in the kit. It does the bulk of the work and the hardest part of it, and yet, without exception, it is given the least



A design for a cross-peen hammer weighing seven ounces, for doing ordinary ...

amount of consideration ... as to quality of mat...

Of the several ... work, two ham... which are suffi... ball-peen and ... to set proper...

the proper hang, which calls for correct proportions in the length from face to face as compared with the diameter, weight and location of the eye. The dimensions given in the detailed drawings are correct for weights of 12 and 7 oz. respectively, which are neither light nor heavy.

A good grade of about 80-point carbon tool steel should be used, forged to size, with just enough metal allowance to finish up. While doing this forging the eye is drifted in the metal. If forging is out of the question the head may be shaped from a solid bar in a lathe and the eye made by drilling out the metal and filing to shape.

The hardening or tempering is very important, for upon this depends the life of the tool. The usual method is to heat it all over to a cherry red, or about 1550 deg. F. pyrometer test in a clean fire, then quickly dip each end—the end only—in water for a distance of about $\frac{3}{4}$ in., until a fine straw color is obtained on each face or end. The steel is then polished, with a coarse grade of emery cloth first and afterward with a finer one about No. 0.

The handles are cut from second growth hickory, well thinned down in the neck so that a spring is formed.—A Dane.

An Auxiliary Chuck for a Carpenter's Brace

IT is a difficult job for a carpenter to hold a small round drill in an ordinary brace, as the chuck opening is so shaped that no grip can be had on this kind of drill. By using the device as shown in the illustration the drill can be held rigid. The pressure exerted by the chuck jaws closes the slot ... on the ... can ... taken ...

Small drill brace chuck

... else a com... drill shanks ... Minter.

Making a Motor-Sled

Fifty miles an hour on the ice

By Clifford A. Butterworth

FOR those who like to make things, there is nothing better to construct than a motor-sled, and there is nothing from which more pleasure can be derived. The one shown in the illustration is capable of making from 40 to 50 miles an hour with a 9-horsepower engine. A 4 or 5-horsepower single cylinder engine will do, but of course it will not be possible to obtain as great a speed as with a twin cylinder engine. The few parts which require forgings can be made by the builder if he has a shop of his own. In case a blacksmith does the work the cost should not be very great. If the builder has a motorcycle he can save the cost of the engine, which is the largest expense. If the sled is well built it should last for years. The following is a list of materials required:

1 Motorcycle engine with ignition and oiling system
1 Motorcycle rear wheel with brake and chain
1 Gasoline tank
2 Pieces of pine 14 ft. long, 4 in. wide and 2 in. thick
2 Ash planks 12 ft. long, 8 in. wide and 1½ in. thick
3 Matched boards 12 ft. long, 6 in. wide
1 Board 2 ft. long and 8 in. wide
1 Piece of iron pipe 6 in. long and 1 in. in diameter
2 Flange couplings
2 Pieces of ½-in. pipe 4 in. long

Number and Size of Bolts Required

[illegible] by ½ in. — 22 Bolts 7 by ½ in.
[illegible] " — 4 " 5 " ¼ "
[illegible] " — 9 " 3 " ½ "
[illegible] " — 18 " 2½ " ⅜ "
[illegible] " — 6 " 1 " ⅜ "
[illegible] Bolts 1 by ¼ in.

[illegible]ber of Iron Pieces

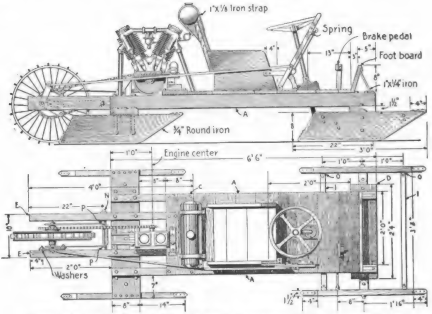
[illegible] 1½ in. wide and ½ in. thick
[illegible] 1 in. wide and ⅛ in. thick
1 Piece 7 ft. long, 1½ in. wide and ⅜ in. thick
1 Piece 11 ft. long, 1½ in. wide and ⅛ in. thick
1 Piece 24 ft. long, 1 in. wide and ¼ in. thick
1 Piece 3 ft. long and 1 in. in diameter
1 Piece 18 ft. long and ¾ in. in diameter
1 Piece 8 ft. long and ½ in. in diameter

Screws, Rivets and Wire

½ Gross of 1½ in. screws
10 Screws 3 in. long
3 Dozen rivets 1 by ¼ in.
8 Ft. of No. 6 wire

Begin the work by cutting the frame pieces *A* from one of the 14-ft. lengths of pine; then cut the pieces, *B*, *C* and *D*, from the ash plank, making them 3 ft. 2 in., 2 ft., and 2 ft. 4 in. long respectively. Bolt them to the frame pieces with the 7-in. bolts. Cut the two 4-ft. pieces, *E*, *E*, and bolt them in position; then cut another piece, *E*, 2 ft. 11 in. long and bolt it to the underside of *B* as shown in Fig. 1, with three 5-in. bolts. These last three pieces are cut from the other 14-ft. length of pine.

Cut the runners from the ash plank and make a V-shaped groove on the edge. This is used to receive the shoe iron for the bottom. Make the groove ¾ in. wide and ¾ in. deep. The shoes are made from the ¾-in. round iron, flattened at the end to ¼ in. and fastened to the runners with three screws in each end. Fasten the rear runners in place with five 3-in. screws through the piece *B* and four iron braces *G*. The steering knuckles are next assembled, as shown in Fig. 2, page 137. The pieces *H* are 6-in. blocks of 2 by 4-in. material fastened to *D* with 8-in. bolts. Bolt the runners on and put the steering rods *I* in place. Washers should be placed under



General plans for the frame and bob sleds, and the location of the engine, tank, levers, steering column, seat and propeller wheel. The dimensions may be changed to suit the needs of the individual builder, but these are right for general uses

all nuts which bear directly on the wood. Put on the foot board and fill in between it and the piece *C* with matched boards. The steering column is now put in place. This is shown in detail in Fig. 3 and 4. The two tapered blocks *J* are made from a piece of the 2 by 4-in. material and bolted to the platform with ¼-in. bolts. The bushing is made of 1-in. pipe with a flange coupling screwed on each end. The collars are also made of 1-in. pe. They are fastened by drilling ough the steering column and using in. rivets. The arm *K* is fastened on making a slot in it 1 in. long and n. wide. The end of the rod is filed t the slot. When in place the rod riveted. The rod *L* is connected the runner by a small angle iron ar to those used for the steering The rod is hammered out to a ter of ⅜ in. at the end and formed n eye which is left partly open. e iron for connecting it to the is put on one end and the eye The other end is then put through the hole in *K* and the angle iron bolted to the runner. The manner in which the steering wheel is fastened depends upon the type of wheel used, and therefore no directions can be given.

The seat may next be made. It is 6 in. high with a back 15 in. high, the boards being cleated together. The driving wheel bracket, crank and connecting link are shown in Fig. 5, 6 and 7. The width of the bracket and the width of the axle slot depend upon the wheel obtainable. The traction band for the wheel is shown in Fig. 8. This is made of 1½ by ⅛-in. iron, with small angles of the same iron riveted to it with the ⅛-in. rivets. Be sure it fits the wheel tightly. Do not forget to have the chain in place before putting the wheel in the bracket. The rod *N* is held in place with cotter pins. Short pieces of pipe are represented by *P*.

The lever details and the rack are shown in Fig. 9 and 10. The rod connecting the lever with the crank is ½ in. in diameter. Make it the right length

so that when the lever is in a vertical position the drive wheel will be raised 3 in. from the ground. The brake pedal is shown in Fig. 11. Its position depends upon the side of the wheel hub chosen for the location of the brake lever. It is connected with the brake lever with the No. 6 wire.

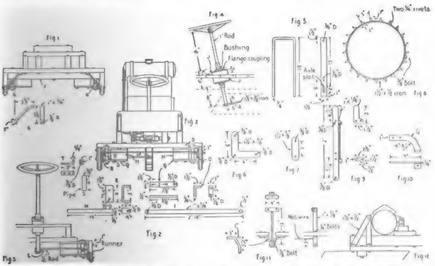
The engine can now be placed and lined up. This must be done carefully, as a very slight error may be the cause of a broken chain. As no two types of engines are mounted exactly alike, it will be necessary for the builder to devise a mounting for the particular kind at hand. One form of support, with perhaps a few alterations, should fit any ordinary engine, as shown in Fig. 12. The exhaust pipes may need to be bent to clear the engine supports. If there is no objection to noise they can be cut off to a length of 6 in. and the muffler discarded.

One way to arrange the engine controls is to run wires or rods from the throttle and magneto to small levers placed at the side of the seat. Means must be provided to keep the levers in position when once set. If the engine is equipped with battery ignition a box for the cells can be constructed under the seat.

Almost any kind of a tank may be used for the gasoline. The one shown was a motorcycle tank 6 in. in diameter and 20 in. long with compartments for both gasoline and oil. If one of this type is not obtainable, a two-quart can fastened to the seat back and connected with the engine by brass tubing can be used for the oil.

With some types of engines it may be possible to provide a crank for starting purposes, otherwise it will be necessary to turn the drive wheel over. If desired, the seat can be made wider to accommodate two passengers, although this will mean changing the position of the steering wheel and lever, and making the seat higher so that the rod from the lever will pass underneath.

While the plans show an open sled, a hood for the front may be attached in order to avoid possible discomfort on a long drive. Such a hood can be made from sheet metal in any desired shape and attached so that it will protect the rider. The hood may be given a form similar to the ones used on automobiles, so that it will come up well over the driver's legs, and should have a windshield at the top to protect the face.



Details of all the parts entering into the construction of a motor sled to be driven by a motorcycle engine of nine horsepower mounted on the rear part of the frame

A Keyless Collapsible Letter Box for Army Camps

THE letter box shown below was originated by a mechanic in the Field Artillery of the U. S. Army. The upper part of the box consists of a wood frame to admit the upper part of

Letter box designed especially for use in the army camp. It is portable

a canvas bag. It is so constructed that when the metal cover is raised the canvas bag is released. Only army officers who are authorized to do so make the collections. The whole device can be readily taken down and packed for shipment.—DUDLEY HESS.

How to Make a Good Lining for Stove Fireplaces

IRON fireboxes, whether made of cast or wrought iron, usually deteriorate when the fires are kept constantly going for any length of time. To prevent this, the stove manufacturers supply their stoves with fireplaces having firebrick linings. Even these in time, due to the action of the heat, break into pieces, thus exposing the iron to the action of the heat. The following cement will take the place of the brick satisfactorily and it withstands heat. Take 6 parts of potters clay, 2 parts of plaster of Paris or cement if obtainable, 1 part of wood ashes, and 3 parts of carborundum in powder form. Mix all of the ingredients in the dry state and then add enough water to make a stiff paste. Apply it to the stove lining where the repairs are required. The carborundum in this mixture helps the lining to withstand the heat, since carborundum is an artificial substance, made under intense heat in an electric furnace.

After the lining is applied to the stove, let it dry for several days, if possible. When starting a fire for the first time, let the fire come to its maximum heat gradually. After that, any kind of firing may be done, as the lining, once having thoroughly dried, will keep in good condition for an indefinite time.—W. S. STANDIFORD.

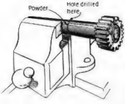
Homemade Copying Paper for Manifold Work

HOMEMADE copying paper, prepared by rubbing one side of common scratch paper with a very soft lead pencil, is more satisfactory for many purposes than carbon paper. For transferring map lines from field sheets to the office map, copying drawings, sketches, etc., it will be found very convenient.

Lines traced on a map or drawing made from such copying paper can be very easily erased. The erasure of the usual carbon-paper lines is not so readily accomplished.—PETER J. M. CLUTE.

Blowing a Pocket Gear From an Automobile Transmission

A POCKET gear on an automobile transmission having a thrust button, became cracked and it was necessary to remove it. The crack caused a burr in the hole that prevented the removal of the gear. The only method that could be used was the usual one of exploding powder back of the pinion stud. A small hole was drilled in the shaft to gain entrance to the space back of this stud and into this a quantity of powder was poured. The powder was ignited with a fuse and the pinion removed.—GEO. F. WEIHER.



Holding part in vise for blowing out the pinion

Simple Designs for Sheet Metal Working

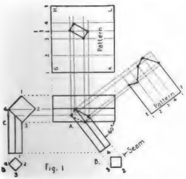
VIII.—Off-center tee joints, any angle, any shape

By Arthur F. Payne

Former Director of Vocational Education, Columbia University

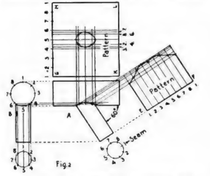
THE four problems in pattern development presented in this article will seem really difficult for the beginner; but those who have worked out the preceding problems, especially those of the last article, will find these easy. They merely require careful work; the methods of working are practically the same as for the preceding problems. Only two new steps in pattern development will be demonstrated.

The method of developing the patterns for the two square pipes intersecting at an angle of 60 deg. off center is shown in Fig. 1. The steps taken are as follows: Draw the front view, *A*, laying out the required angle as explained in last month's article; draw the bottom view of the small pipe *B*; number the four corners as indicated; draw the end view *C*; draw the bottom of the small pipe *D* of the end view and number the corners as shown, taking care to keep the numbers in the proper relation to the front view. Notice that the pipe has been turned, for this affects the position of the numbers.



Method of developing patterns for two square pipes intersecting at an angle

A new step in pattern drafting must be learned before we can develop the pattern for the small pipe. The front view *A* must be completed by showing exactly the shape of the joint where the two pipes come together. This is done in the following manner: Place a pencil on the point 4 on the bottom of the end view; follow the line upward until it touches the large pipe, then run the line



This problem is a little more complicated but is worked out in the usual manner

over to the front view *A* until it crosses the line coming up from point 4 on the bottom of the front view. Make a cross where these two numbered lines cross each other. Do the same with the other three numbers. Connect the four crosses with straight lines, and you will have an exact drawing of the joint. Notice that the two lower lines of this joint are drawn in dotted lines. This is to show that if the joint is made in metal these lines will not be seen because they will be back of the small pipe.

To develop the pattern for the small pipe, proceed in the usual manner as explained in previous chapters. Draw the base line *E*—*F*, transfer the distances from the bottom view to get the correct length, extend the lengths of the pipe from the front view until similarly numbered lines cross each other, one line coming up from the base line and the other coming across from the front view.

When the intersections of these lines have been marked with a cross, connect the lines with straight lines and the pattern will be complete. Make allowances for seams and laps.

To develop the pattern for the large

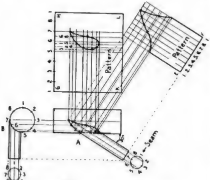


Fig 3

In the working out of this problem two additional steps are taken

pipe proceed in the same manner as described in the last article. First draw the lines *G—H* and *K—L*, obtaining the correct length by transferring the distances from the points on the end view as was done in the problems in the previous article; then run the lines up from the joint on the front view. Where the same numbered lines intersect, make a cross.

Now we come to the first new step required by this problem. No difficulty will be found with the lines 3 and 4, as it will be seen from the end view that lines 4 and 2 of the small pipe rest on them, but when you come up with lines 3 and 1 from the front view you will find that you have no place for them. By looking at the end view of the large pipe it will be noticed that lines **1** and **3** of the small pipe meet the large pipe exactly midway between 3 and 4 on the pattern. The point where the lines 1 and 3 from the front view cross this line marks the location you are trying to find, as shown in the drawing.

The second problem, Fig. 2, is worked out in a similar manner, but is made a little more complicated by the fact that it requires more extra lines to locate the pattern for the hole in the large pipe.

Briefly, the steps to be taken are: **Draw** front view *A*, end view *B*; complete the front view *A* by drawing the joint. Do this in the manner described in Fig. 1, this being one of the two new steps mentioned in the first paragraph; develop the pattern for the small pipe, in the manner already described, drawing the base line *E—F* and obtaining the correct length by transferring the distance from the bottom view; run the lines upward from the base line, and the lines over from the joint line, and where the same numbered lines intersect make a cross to indicate the pattern line.

To develop the pattern for the large pipe, draw the line *G—H* and *K—L*, obtaining the correct length by transferring the spaces from the end view.

Now we come to another of the new steps in these problems. By looking at the end view you will notice that the hole in the large pipe will be between numbers 4 and 6, and that the hole does not rest exactly on the numbers. We also see that number 7 of the small pipe coming up from the bottom view meets the large pipe a short distance away from number 6. With the dividers, measure that distance and transfer it to the pattern as indicated by lines **6** and **7**

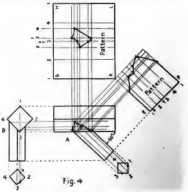


Fig. 4

A little different application of one of the new steps is shown in this problem

on the pattern. Lines 8 and 6 with 2 and 4 are a short distance away from 5 of the large pipe. Mark the distance on the pattern and number the lines with the same numbers as the spaces on the small pipe. Then from the front view

joint line run the lines up until the same numbered lines cross each other. Mark with crosses and connect with a curved line as indicated in the illustration, and the pattern is complete.

In the development of problem Fig. 3, the steps taken are exactly the same as the foregoing; in fact all the problems in this article and the previous one are based on the same principles, the only difference in method being the two new steps involved in the problems in this article.

In problem Fig. 4 we have the same principles and method with a little different application of one of the new steps. Draw the front and end view locating the joint line; develop the pattern for the small pipe as previously explained. When we come to develop the hole in the large pipe we will find that two extra points $X-Y$ will be needed on the bottom view to indicate where point 3 of the large pipe comes in contact with the small pipe. We know that this point 3 will cause a change in the pattern of the small pipe in two places somewhere between points 1 and 2, also between 2 and 3; the exact distance can be found by measuring the space on the large pipe.

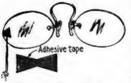
Proper Care of Shoes to Make Them Wear Longer

It is possible to take such good care of your shoes that they will wear twice as long and look well to the last minute. In the first place, buy shoes that fit properly. Well fitting shoes will always outlast shoes that are either too tight or too loose a fit.

Remember that patent leather shoes and light weight footwear are not intended for hard service and consequently will not withstand rough wear. Be fair to your shoes and do not expect of them ... were never designed to give. ... leather is likely to crack and ... against this is made by the ... of shoes. When the shoes ... careful in drying them not ... too near the fire, as they ... too quickly. This takes ... of the leather and destroys ... Therefore, do not attempt ... shoes too quickly when they are damp. If your shoes are cleaned and dressed with proper dressing, they will wear twice as long. To keep them soft and pliable, there is nothing better than "neatsfoot" oil, which is inexpensive and can be bought at any leather or harness store. This oil is not a patent preparation, but is an oil that is used extensively by all harness makers to keep their goods in fine condition. Applications of this oil, say once a week, will keep the leather pliable and wear-resisting.—W. S. STANDIFORD.

Attaching a Cord to the Glass of Nose Spectacles

For a time I used a pair of borrowed nose glasses which had no hole for a cord, and fearing they would fall off and break I attached a cord temporarily by using a piece of adhesive tape. The tape was cut as shown and stuck to one glass, holding beneath it the loop of the cord.—JAMES M. KANE.



Shape of tape and manner of attaching to glass

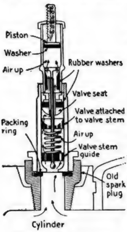
How to Engrave Your Name on Steel or Iron Tools

To engrave your name on steel or iron tools, melt some paraffin wax in a tin can, old saucer or other suitable container; take a brush and coat the surface with the wax, then let it cool. When the wax hardens, draw the design or name on it with a scriber or other sharp instrument, taking care that the sharp point of the scriber goes through the wax and bites or scratches the metal underneath the wax. Then take a fountain-pen filler or a hard wood stick whittled to a point, and dip it into nitric acid, letting the drops penetrate through the name or design on the wax.

Be sure to cover all of the name with the acid, letting it remain on the metal for about five minutes, so as to get deeply-cut letters. Rinse the acid off with water, and heat the metal until the wax melts; then wipe it dry.

Testing Cylinder Pressure With an Ordinary Tire Gage

OWNERS of automobiles who want to know the amount of pressure in each cylinder of their engine, can obtain this information in a simple manner by following the example of Sterling Waggoner, of Putney, South Dakota. He takes a valve stem from an old inner tube and fastens it into a spark-plug base so that it is air-tight. Then he holds a tire-gage over the valve, while someone turns over the engine by hand. In a few minutes he determines which are his weak and strong cylinders.



Pressure gage attached to the cylinder head

In making the device, all that is necessary is a threaded connection to fit the spark-plug hole in the cylinder, into which is fitted the extension barrel holding the pressure gage. The air pressure forces up the gage valve which, as is generally known, remains at the highest point. This can be read at any time after making the test until the gage is again set.

Solution for Removing the Rust from Drawing Instruments

THE following method of removing rust from drawing instruments is only applicable to those pieces that are spotted with rust and not to those that need regrinding. A saturated solution of tin (stannous) chloride should be prepared, and the instruments permitted to remain in the liquid overnight. They are then rinsed in running water, and rubbed with a chamois skin until thoroughly dry. The rust is removed by the reducing action of the tin chloride. Polishing powder is necessary to restore the original luster of the instrument.

Portable Scaffold for Putti Vertical Siding

ON this scaffold a workman on barn siding, or doing work, can remain in a perfectly able position and nail two or thr of siding to three nail ties withou to shift. After this he moves his into position for nailing the of boards by simply sliding it a top of the upper nail tie as s the illustration.

The scaffold is made of the f material: One board 1 in. by 12 enough to more than reach ac three nail ties; one piece 2 in. 12 in. long and just a trifle wic the top of the nail tie, to be nailed to the upper end of the b and another piece 2 by 4 by 12 in to this in such a way as to pı hook by which the scaffold can pended to the upper tie. One board 1 by 12 by 16 in. is fastened and braced at some co

The scaffold seat is hooked over the u plate on which it slides to pos

place near the lower end of th board to provide a platform upon the workman may stand or sit comfc while he is nailing on the siding.—L. BLICKENSTAFF.

How to Shoot Birds on the Wing

You aim where the bird isn't, so that he and the bullet meet at the intended spot

By Edward C. Crossman

THERE is one great rule in successful shotgun shooting—don't shoot at the bird; shoot where he's going to be. There are exceptions of course, but as a rule shooting directly at a flying object with the shotgun means a miss.

Don't shoot at the bird. Aim at the spot where he is going to be

Probably the most exasperating set of figures in the world, and the most useless in actual practice, are those which pertain to the time of flight of a charge of shot; the bird's speed and its exact distance from the gun. Mathematically simple is the problem of putting the center of a shot charge precisely over a bird flying at a given distance and at a given speed. It is simple enough to calculate the distance a bird will fly in a given time and then to calculate the time the shot charge takes in getting to the bird, and so the distance the gun must be pointed ahead. The little joker lies in the fact that in real life at least two unknown quantities enter into the problem—first the distance to the bird, second the speed of the bird. So quickly does the whole thing happen that the shooter has no time to find out the distance to the quarry, while the speed of birds varies. So successful shooting becomes a matter of experience, governed by a sort of sixth sense which is eventually acquired by the veteran scatter-gunner.

If the bird is a crossing bird and flying 40 miles an hour at a distance of 40 yd., then he's traveling in round numbers 60 ft. per second, and in a tenth of a second, 6 ft. A charge of shot of size used for upland birds, takes .14 sec. to travel 40 yd. In .14 sec. our bird travels 8.4 ft. There is also a slight delay after one's brain signals the finger to pull, which amounts to one .01 of a second and up, or say six inches more travel by the bird. So the hapless wight firing directly at his bird, misses him by nine feet, less a foot or two for the spread of the pellets which might have gotten the bird had the charge passed within a foot or two of being right.

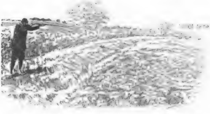
So comes the necessity for either holding ahead or swinging ahead of any bird going at an angle to the line of fire, and the necessity for throwing the gun muzzle ahead of the bird regardless of its direction, distance or speed. The spread of the pellets—giving a killing circle 35 in. across at 40 yd. in the case of the full choke gun and more in guns not so

Where to aim at a bird that has approached and is passing the hunter

much choked—takes care of some error in holding, else few of us would ever hit a bird; but the man who depends on the spread of his shot to connect is going to believe after a bit that his "pattern," the spread of the shot, isn't much wider

than an ordinary small-sized saucer.

The good shot usually swings ahead of his bird and keeps on swinging as he presses the trigger. Some men swing



Where to aim with the second shot when the birds have passed and are going away

up from behind and swing very rapidly past, pulling when they feel they are far enough ahead. Others throw the gun up ahead of the bird and swing along at about the speed of the flyer. The man who swings rapidly by the bird has to lead it less than the man who swings at bird speed, because the speed of his gun-swinging carries him farther ahead than he realizes by the time the charge is out of the barrel. Few men can hit consistently by holding ahead of a bird—holding the gun still at a point they consider correct. The slightest delay in pulling the trigger means a miss—a tenth of a second means six feet, in our hypothetical reasoning. A delay while the gun is swinging, however, means nothing, because the muzzles are still keeping ahead of the flyer and so are aimed at about the right spot for shot load and birdie to intersect.

While many men learn early the necessity for the generous swing ahead and lead on the crossing duck, they fail to grasp the fact that the quail, apparently angling off so little that they can hit it by shooting right at it, is really moving fast either to the left or right. Therefore they shoot right at Brother Quail who is buzzing off to the left and forward, and the shot load hisses by the bird to the right. The aim was correct for the spot where the bird was—but not where he was when the shot got there.

Making a hit by a direct aim at a bird flying straight away from the hunter

Clay bird shooters have the same experience when they shoot right at the clay angling off from the straight line to the gun. To hit the angling bird, therefore,

...nd rises and flies very low—just skimming away—the gun should be aimed so as to ...l over or in advance of the bird. The tendency is to wait too long to shoot

the wise gunner puts the muzzle a foot or two to the left or right of the bird, as he may be angling from the straight

When the bird is ascending the hunter shoots well over him to make sure of a hit

line. No swing is possible, because the distance from the straight line is slight.

The soaring bird is another deceiver of the simple huntsman. No old duck shot needs to be told how much one has to hold over the duck which leaps from the reeds and darts almost vertically for the blue voids. I remember shooting about one box of shells at a covey of quail, broken up and lying just over the crest of a rocky ridge. The birds simply dropped down the ridge like stones, and most of the box of shells went while I was thinking that I had to hold lower and lower below the dropping bird to make the shot charge intersect his flight. When I saw two or three feet of daylight 'twixt the muzzle of the gun and the bird above, then the bird usually quit flying and went tumbling down the slope.

All of this holding where the bird isn't and all this swing prove necessary merely because of the relatively slow flight of shot, which has about the velocity of sound for a short distance, and then less as the range grows longer. If we could give shot the sustained velocity of our Government rifle, hitting with the shotgun would be a matter merely of holding correctly on the bird—and so "like shooting fish."

As I have said, applying the mathematics of the case to the actual shooting is difficult, because of the unknown factors in the problem; but it is possible to get an approximation of the right distance ahead necessary for the various ranges, and so avoid the inclination to shoot behind the bird, which is the most common fault of the shotgun man.

A load of No. 7 shot flies like this over the various ranges:

Range	Time of Flight	Average velocity	Velocity at end of range	Lead necessary for bird flying 60 ft. per sec.
20	.0611 sec.	1050	860	3 ft. 8 in.
25	.079 "	1000	800	4 " 9 "
30	.0985 "	950	740	5 " 11 "
35	.1194 "	900	700	7 " 2 "
40	.14 "	875	650	8 " 6 "

The speed of birds is usually overestimated. British experiments with accurate time-measuring apparatus years ago showed that pheasants fly little more than thirty miles per hour in the open, while the buzzing partridge, like our own quail, flies less than this. The duck, down-wind, is the fastest thing our gunners have to shoot at, but it is doubtful

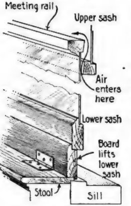
The hunter does not aim at the spot where the rabbit is but at where he is jumping

if they get up over 60 miles an hour despite all the yarns of the returned huntsman.

The same general rules which are given for shooting birds on the wing also apply to rabbit hunting. The rabbit usually gives the hunter only the slightest glimpse of him in passing an open stretch of ground, so that some rapid calculations must be made in order to hit him at the next clearing.

A Simple Cold-Weather Ventilator for the Window Sill

FOR very cold days, when drafts would be objectionable, the simple ventilation device shown in the drawing will be appreciated by everyone. Fit a board 1 in. thick, 1½ in. wide and 4 in. long by hinges to the stool of the window, rebating the top so that when the board is set vertically it will hold the lower sash of the window up. This permits the air to come in between the upper and lower sash without draft, while the opening at the bottom is closed with the board. The bottom of this board, as will be seen, is also rebated to fit over the stool.



Hinged board under lower sash to raise window for ventilation

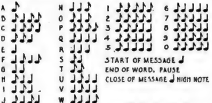
When the window is to be closed the board is pulled over into the flat position on the window stool. The hinges should not be set flush into the stool and board, because extra play is needed for it to fall into position. The ventilation afforded between the two sashes is sufficient for ordinary purposes on cold and windy days.—HAROLD V. WALSH.

Joining Pieces of Rubber by the Use of Heat and a Glass Rod

IN the chemical laboratory small pieces of tubing are [illegible] because a satisfac[illegible] them to form a [illegible] With a gla[illegible] very g[illegible] sh[illegible]

Using a Bugle to Transmit Telegraph Signals

ALMOST every person is familiar with the idea of sending messages by the wigwag system of flags, but here is a code by which messages may be transmitted within the range of a bugle



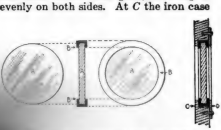
Code for use in sending signals by bugle call

sound by quarter and half notes. There is not anything difficult about the code and it can be learned almost as quickly as the bugle calls.—THOMAS MCHUGH.

A Waterproof Mounting for a Circular Piece of Glass

A VERY good method of securing a circular piece of glass in a metal frame, and at the same time making it waterproof, is shown in the illustration.

The circular piece of glass is shown at *A*, and at *B* is shown a rubber band stretched around the glass, dividing it evenly on both sides. At *C* the iron case



A rubber band stretched over the edge [illegible] glass and pressed in the metal rim

[illegible] glass is set is shown, and *D* [illegible] the metal rim, screwed down by fine screws, which exerts a pressure [illegible] rubber band, thereby securing waterproofing the glass. The rubber [illegible] surpasses putty, felt, etc., in neat[illegible] and durability.—WALTER B. WEBER.

The Amateur Electrician And Wireless Operator

Resonant Annunciator to Operate on Alternating Current

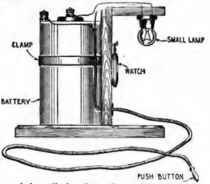
HERE is a method of constructing an annunciator to operate on a 110-volt alternating current that is very simple, yet efficient. There are no sparking contacts in this annunciator; nevertheless it admits of a wide range of tone adjustment and gives forth a powerful buzzing note that is exceptional because of its unusual resonance, its extremely low pitch and enormous volume. The pitch may be regulated to a higher frequency and smaller volume, which may be necessary when the far-reaching, low, powerful note is not desired, as may be the case when there is someone ill in the house or where for any other reason it is necessary to minimize the noise of the instrument.

The annunciator consists of nothing more than a 75-ohm watch-case receiver. The cover of the receiver should be unscrewed nearly all the way when the low pitch is desired. By screwing the cover on tighter, the pitch is raised. To secure best results, the receiver should be mounted at an angle slightly off vertical, or in other words, with the face of the receiver-cover tilted downwards. A 60-watt lamp or something equal in resistance to it should be placed in series with the annunciator in order to lower the amperage of the current passing through it and thus serve to protect its windings.

The device will consume hardly any current at all and an ordinary push button may be used; but the wiring and insulation should be much heavier than for ordinary battery annunciators. It is, of course, readily understood that the buzz produced is the effect of the rapid alternations in the current.—JOSEPH BRAFF.

Making a Night Light of Battery Cell and Miniature Lamp

A SIMPLE, yet efficient night light can easily be constructed by following the instructions outlined in the accompanying illustration. If the necessary materials are not at hand, they may be purchased at any electrical store. The base and the upright are made of wood, and fastened together with two flat-headed screws. A felt pad, cut to shape and pasted on the bottom, will prevent the polished surfaces from being scratched.



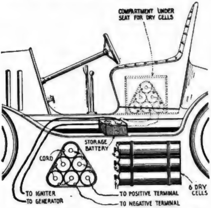
A dry cell placed on a base with upright to hold watch and lamp for a night light

The battery is held in place by a wire bound around it and attached to a staple on either side. The lamp, preferably a 2½-volt tungsten, is connected in series with the button and battery. For running the wires from the lamp to the back of the board, insulated staples should be used.

A twisted No. 20 lamp cord is used. Its length depends upon the distance between the bed and the article upon which the night light is to be placed. The sketch shown above makes the construction clear.—H. NEUHAUS.

An Emergency Battery for Starting an Automobile Motor

AT least 50 per cent of the modern automobiles use battery ignition. As this system sometimes gives trouble, even in the most expensive cars, I de-



A set of dry batteries placed under the seat to aid in starting the automobile motor

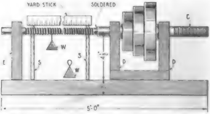
vised a method for producing an emergency current as shown in the illustration. This consists of six dry cells securely tied together in a triangle shape and wired in series with a 4-ft. length of well insulated copper wire attached to each of the negative and positive terminals. These wires are used to make connections with the storage battery terminals for starting the motor; then they are disconnected.

The batteries will last a long time for this emergency work. If the storage battery gives too much trouble, remove the filling caps and make sure that the liquid is ½ in. above the top of the lead plates. Should the level be below this point, add enough distilled water to make up the deficiency. Keep all the battery and wire terminals bright by scraping them with a sharp knife about once a month, and make sure that there is no short circuit in the dashboard switches and that no battery wire or other wire is chafing against any metal to produce a short circuit. In this way a battery may be kept at its highest efficiency.—P. P. AVERY.

A Winding Machine with a Revolution Counter

THE winding machine shown in the drawing is of service for winding various types of coils, transformer "pies," etc., in the amateur's shop, or wherever there is no small screw-cutting lathe. The novel feature of the machine is the simple method employed for determining the number of revolutions the spindle makes during the process of winding a coil.

A piece of round stock, *C*, ½ in. in diameter and 12 in. long, is threaded 3 in. of its length at one end, and has a 3/16-in. hole drilled in the opposite end to a depth of ½ in. A three- or four-step set of cone pulleys is made fast to the center of *C* by keying or with a forced fit. The spindle is mounted in bearings upon standards *D* as shown, and the spindle unit thus assembled is permanently fastened to a baseboard 2 in. by 6 in. by 5 ft. A piece of 3/16-in. round rod 3 ft. 4 in. long is then threaded with a die, cutting 32 threads per inch for its entire length with the exception of about 2 in. at one end. The stand *E* is made and fastened to the baseboard at the point shown, and acts as a bearing for one end of the threaded rod. The end of the rod left unthreaded is now inserted in its bearing in the standard *E*. The opposite end is inserted in the hole drilled in the end of



A threaded rod on the lathe spindle registers the exact number of turns of wire on the coil

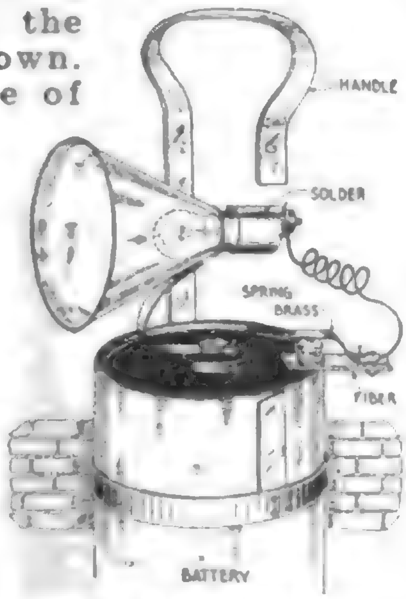
C, to which it is soldered. A yard stick is mounted in line with the threaded rod and directly above it, and is held in place by two strap-iron standards *S*. A loop of fine iron wire is passed around the threaded rod, the ends are twisted together and a small lead weight is fastened to the twisted ends as shown

at *W*. The machine is now completed and ready to operate.

It is to be driven by a small motor, bolted so that the spindle turns away from the operator. The rider *W* is placed at a point directly below the zero on the yard stick, which should be at the left end if a right-hand thread was used. When the motor is started the spindle revolves, the rider follows the thread and moves along the threaded rod. When the rider has moved a distance of 1 in., 32 revolutions have been made by the spindle and a corresponding number of turns wound upon the coil under construction. When the rider has moved the full length of the yard stick, the spindle will have made 32 times 36 = 1152 revolutions. The rider is then replaced at zero and the winding and calculations continued.—H. W. OFFINS.

A Homemade Electric Lantern for a Dry-Battery Cell

THIS lantern is constructed from an ordinary dry-battery cell $2\frac{1}{2}$ in. in diameter and 6 in. long. and a tin funnel $2\frac{1}{2}$ in. in diameter. The spout of the funnel is removed and a small electric bulb of one volt is fastened into the funnel as shown. From a piece of heavy galvanized sheet iron cut a strip $\frac{1}{2}$ in. wide, having a length sufficient to make a clamp and carrying handle. Make a small thumb-switch of a piece of 1/64 by $\frac{1}{4}$-in. spring brass. This should be located near the carrying handle.

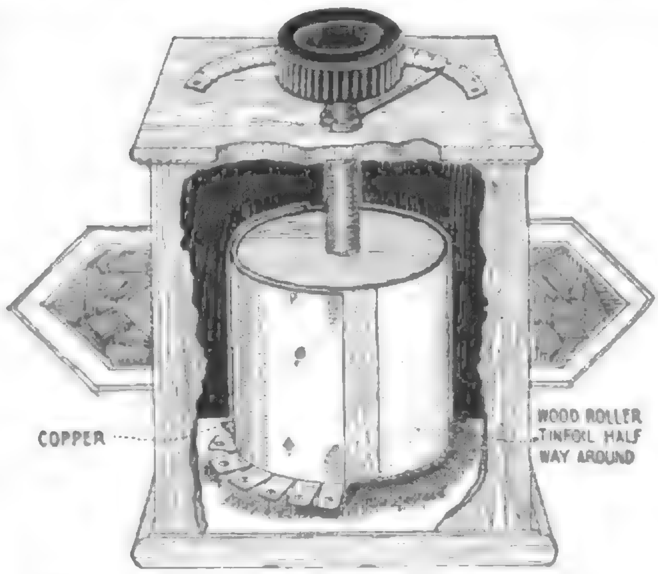


Handle attachment and connections to battery

An old electric bulb from an automobile side lamp may be used, or a one-volt lamp with a brass screw socket and a porcelain base will answer the *purpose*. Secure the funnel reflector to the battery with a brass clamp, and when the battery is used up unscrew and connect with a fresh one. This provides a powerful and handy electric lantern which is as easy to carry as the old barn lantern and which is more satisfactory.—P. P. AVERY.

An Easily Constructed Variable Condenser of Brass and Tinfoil

MAKE a wooden roller 3 in. in diameter and 4 in. long, as shown,



Wood roller with tinfoil half way over the surface to vary the capacity of the condenser

and mount it on a shaft, which may well be of $\frac{1}{8}$-in. brass rod. Thread one end of the shaft so that a wooden knob and metal pointer may be screwed in place. Coat one half of the surface of the cylinder with tinfoil, and solder a fine wire connection from the foil to the shaft. The shaft should project about $\frac{1}{2}$ in. from the cylinder at one end and about $1\frac{1}{2}$ in. at the other (which carries the knob and pointer), according to the size of the cabinet to be used.

Make a half-cylindrical piece of thin sheet brass or copper a trifle larger than the wooden cylinder, bending out supporting feet as shown. When these two parts are finished, the condenser may be assembled.

When the knob is turned, more or less of the tinfoil is presented to the sheet of brass or copper and consequently the effective capacity is varied. Connections are made with the shaft and the fixed sheet of tinfoil and with the brass or copper shell which is around the outside of the roller.—THOS. MILLSBAUGH.

Making an Electrically Heated Blue-Print Dryer

At times atmospheric conditions make drying of blue prints very slow, and when it is necessary to hurry up such work some means of drying by heat must be employed. The illustration shows an electrically heated chamber for the purpose. The dryer inclosure consists of composition board applied to a light frame of wood 2 in. square, of the dimensions given.

The top piece of the box is perforated to cause a circulation of air. A wire *A* is stretched from corner to corner on both upper ends of the sides to provide a support for the dryer frames. These frames are constructed as shown at *B*. The frames are built of furring strips and cheesecloth, drawn tightly and tacked to one side to make a surface having considerable absorption. As many of these frames may be used as may be required for the inclosed space.

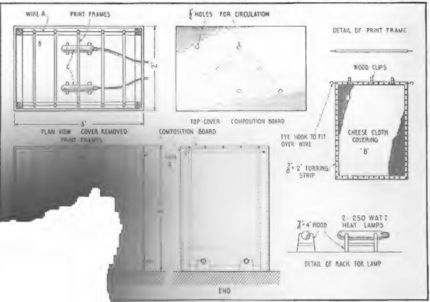
At the base of the inclosure two racks are made to hold two 250-watt heating lamps. Metal or asbestos should be used in the notches to avoid the possibility of the heat from the lamps burning the wood. Over-drying should also be guarded against.—J. E. Cahill, Jr.

How to Insulate the Ends of Chair Posts

A chair that is provided with insulation against electrical surges is invaluable for safety and efficiency in electrical operations, such as wiring, telegraphy, or high frequency work. Most chairs may be very easily adapted to such a use.

Four large common green glass insulators, such as are used on the crosstrees of telegraph poles, should be obtained. The four feet of the chair should be made to fit tightly into the holes of the insulators.

Since the hole in the bottom of the insulator is threaded, the insulator should be twisted on with a rotary motion. Besides insulating the chair, these insulators will serve in the place of domes for the legs of the chair.—Joseph Braff.



...of composition board with frames covered with cheesecloth ...may be hung over electric heating lamps and dried quickly

Electrical Devices and How They Work

Primary Battery Cells—I.

This article is the first of a series on electricity, each one of which is complete in itself. Some interesting experimental problems are illustrated and very explicitly described

By Peter J. M. Clute, B. E.

THE agency which comes into action when a circuit containing an electromotive force is closed is called electric current. This current flow is analogous to the flow of water in pipes, or over the surface of the earth. Such a flow of water takes place only when from any cause, a difference in pressure exists between two points, or when the water is at different levels. When either of these conditions exists, the flow takes place in a certain direction; namely, from the higher to the lower level, the amount of flow being dependent upon the obstacles in its path. Electric currents, likewise, flow only in obedience to electrical pressure, and the quantity of current flowing is dependent upon the resistance to the flow offered by the circuit.

A simple primary cell is shown in Fig. 1. It consists of a glass jar nearly filled with a dilute sulphuric acid solution, into which are placed a plate of zinc and one of copper. While the ends of the wires connected with the plates remain separated, no current flows; but an electrical pressure exists, as can be readily shown. As soon as the ends of the two wires are brought into contact, a flow of current commences. It is the high resistance of the air between the two terminals which prevents the flow of current in this case, just as the presence of a closed valve in a waterpipe prevents water flow.

The current itself cannot be seen as it flows through the wire, but its effects are evidences of its presence. A current flowing through a thin wire will heat it; flowing through water and other liquids it decomposes them; flowing near a magnetic needle it will cause it to deflect. All these phenomena cease at once when the current is interrupted, either by breaking the circuit or by separating the acid around one plate from that around the other by a non-conducting partition.

The direction of current is said to be from the zinc to the copper inside the cell and from copper back to zinc in the external circuit. In all cells the plate, or terminal, from which the current flows, is called the positive pole, and the terminal toward which the current flows in the circuit is the negative pole.

From the cell shown, Fig. 1, which is the simplest of all forms, a very insignificant current is given. If several cells

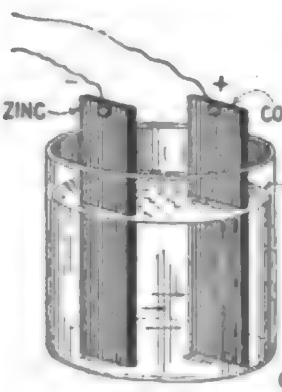


FIG. 1

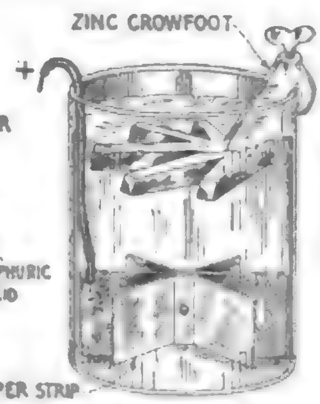


FIG. 2

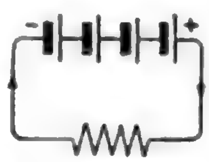


FIG. 3

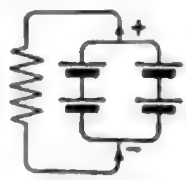


FIG. 4

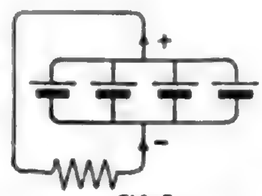


FIG. 5

The simplest form of battery, the primary cell, and the gravity cell with wiring diagrams

are coupled together, as conventionally indicated in Fig. 3, 4 and 5, a considerable current is obtainable. In this representation, the long thin lines indicate the positive plates and the short thick lines the negative plates.

The term "battery" is applied to a number of cells grouped together either in a series or in parallel and should never be applied to a single cell. Representa-

tive battery groups are shown in Fig. 3, 4 and 5. For all ordinary work, the method of connections in Fig. 3 is employed, where the voltage of the battery is four times as great as that of a single cell. If the same four cells are grouped as in Fig. 4, the voltage will be but twice that of one cell, but the strength of the current will be twice that of Fig. 4. When arranged in parallel, as in Fig. 5, the E. M. F. will be equal to that of one cell, and the current four times that obtained when the cells are connected in series. The voltage of a number of cells in series is equal to the voltage of one cell multiplied by the number of cells.

The voltage obtainable from any cell is independent of its size or of the distance between the plates. For any given cell, however, the current is directly proportional to the size of plates, and inversely to the distance between them. Thus, the distance between the plates affects the current only, as it increases the internal resistance.

The resistance of a number of cells in series is equal to one cell's resistance multiplied by the number of cells. When arranged in parallel the total resistance is equal to the total resistance of one of the cells divided by the number of cells in parallel.

Primary cells are divided into two classes. One class is suitable for continuous work only, and will quickly run down unless connected in the circuit; this is the closed-circuit type. The other will rapidly deteriorate when continually used; this is the open-circuit type.

The best known of the closed-circuit type is the gravity cell, shown in Fig. 2. The positive pole, or cathode, consists of copper located at the bottom of the jar, and the negative pole, or anode, of zinc crowfoot arranged at the top. Both are immersed in a copper-sulphate solution. This type is suitable only for such [illegible] as telegraphy, or wherever small cur[illegible] are used, since [illegible] the cell is gre[illegible]

Open-ci[illegible] tensive[illegible] [illegible]

dioxide and carbon mixture surrounding the central carbon rod. The whole is saturated with ammonium chloride solution and sealed with pitch to keep it from drying out.

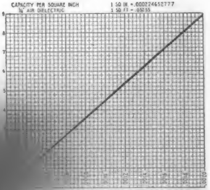
Apart from dry cells, the Leclanché cell is most used. In this cell the cathode is of carbon immersed in sal ammoniac solution, and the anode is a bar of zinc immersed in the same liquid, but insulated from the carbon. Such cells can deliver a strong current for a short time. If left in circuit, however, they will run down in a short time. These cells are universally used for bell and telephone work, and in places where intermittent current is desired, as they consume no energy when not in use.

(*To be continued*)

A Simple Method for Determining Condenser Capacity

A QUICK and easy method of calculating condenser capacity by simple arithmetic, will appeal to all experimenters, and particularly to those of the younger class who have not reached that stage in the study of mathematics at which they are able to handle formulae. The curves shown here may be used.

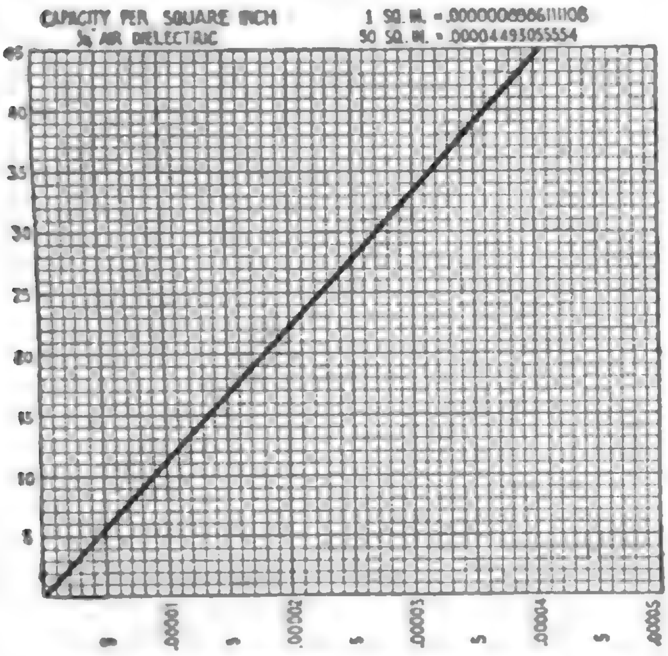
As an example of their use, suppose it



[illegible] shows that a condenser will need [illegible] 10 square inches of active dielectric

[illegible]d to build a mica stopping con[illegible] of .002 mfd. capacity, and the [illegible]vailable for use as the dielectric [illegible]res 8 mils in thickness. From the

first curve it is observed that a condenser of this value having air as a dielectric 1 mil in thickness will require 8.9 sq. in. of active dielectric. But the mica is 8 mils thick. A condenser with an 8 mil



This curve is useful for calculating the capacity of glass plate transmitting condensers

air dielectric and still having a capacity of .002 mfd. would require 8.9 x 8 = 71.2 sq. in. However, the specific inductive capacity or dielectric constant of mica, as obtained from a standard text book is 6.64; that is, the ratio of the values of capacity of two identically constructed condensers, one with air dielectric and the other mica, is as 1 to 6.64. Therefore, 71.2 ÷ 6.64 = 10.72 square inches of active dielectric of 8 mil mica will be required for a condenser of .002 mfd.

The second curve will be found useful for calculating the capacity of glass plate transmitting condensers, and is used in the same manner.

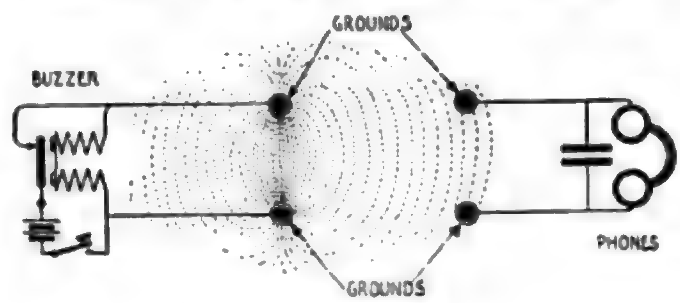
A Fire-Proof Whitewash that Will Not Rub Off

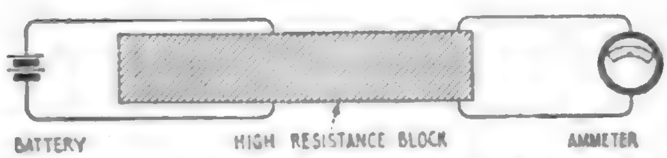
A FIRE-PROOF whitewash can be readily made by adding 1 part silicate of soda—or potash—to every 5 parts of whitewash. The addition of a solution of alum to whitewash is recommended as a means to prevent the rubbing off of the whitewash. A coating of a good glue-size, made by dissolving ½ lb. of glue in a gallon of water, is good w[illegible] a wall is to be papered.

Telegraphing Through the Ground by Wireless

BECAUSE the Government, for good and sufficient reasons, has put a ban on amateur wireless stations, it does not follow that all your activities must stop. There is much left that may be done. Your radio efforts can be diverted to communicating by ground wireless, which is almost as interesting. You will do well to put in a little of your spare time reading and studying more about the "stuff" that electricity is made of, the nature of wireless radiations, and the like.

Telegraphing through the ground is permitted by the Government, since high tension apparatus need not be used, at least not in their normal capacities. A





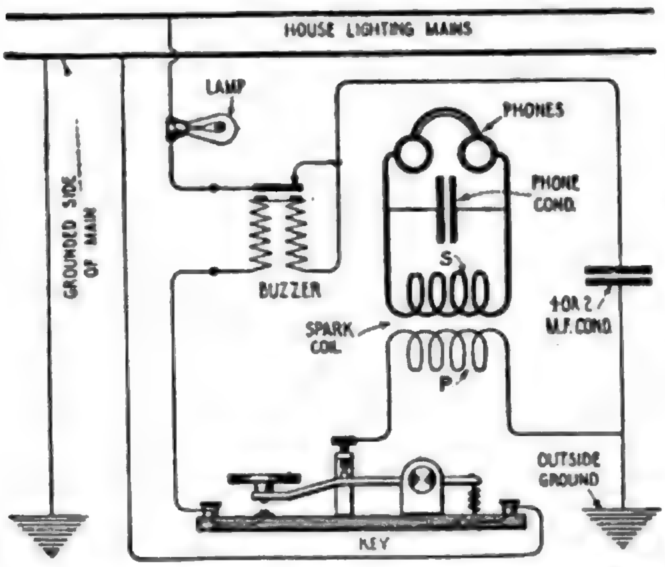
Currents from the buzzer are conducted through the earth just as they would be through a shunt to an ammeter

simple buzzer, supplied with a current of half an ampere, is sufficient in this system to send a distance of from one to forty miles under favorable circumstances, but this distance is constantly being increased by amateurs who are already experimenting.

The present importance of ground telegraphy is not generally appreciated by America and her Allies. For all we know, the Germans may be using it now. If we can send forty miles with it through the highly-resistant earth, considerably greater distance can be covered through water. The announcement by two Virginia men that the system can be successfully employed for communicating between submarines is therefore of the utmost significance. Notwithstanding the simplicity

of the apparatus, it may be outdistancing all other sub-sea methods in range.

The principles upon which ground wireless telegraphy works are interesting. Ordinary electric current conduction is the operating factor, instead of radiation as in radiotelegraphy. The coils of the sending buzzer are connected with two grounds, as shown in the diagram. At every break of the circuit caused by the buzzer armature, the inductive discharge that ordinarily causes a spark at the



A complete, practical break-in system to start with in "through-the-ground" operation

armature contacts, discharges to the earth. The relative high voltage sends an electric current from one plate to the other.

It is obvious that we have not merely a narrow conductor between the plates, but a conductor which is as big as the earth! The result is that, while most of the current going from one ground to the other takes the straight-line route, a good part of it spreads out. The lines of flow in reality appear just like the lines of force which are shown by iron filings between two opposite magnetic poles.

Some of these far-spreading streams of current will reach the buried plates of the receiving station. The leads of the receiving station will "tap" these streams—which are highly pulsating—and a telephone will detect them.

This at once explains why the line going through the plates of one station should be parallel to that going through the grounds of the other. Another fact that is found by experience is that the further the grounds of each station are separated, the louder will the received signals be. This second phenomenon can be explained by referring to the diagram. Here an ammeter is connected with a battery through a metal block of high resistance. This block stimulates the action of the ground between the two wireless stations. It is very much like an ordinary shunt that is put across an ammeter. The greater the resistance of such a shunt, the less current will go through it and the more will go through the ammeter.

Now, in placing the grounds of the stations farther apart, we increase the distance across the theoretical block. Hence, the metal that the current must cross, and the metal's resistance will be increased. The ammeter will then receive more current. For just such reasons, when the actual grounds are buried farther apart, the telephones will receive a larger current.

In practice, you should space your grounds at least twenty feet apart, though it would be much better to have them separated over fifty feet. The neatest and most efficient hook-up to start with is shown in the diagram. Here the house lighting mains are utilized, with a bank of lamps to cut down the voltage. The arrangement enables you to use as much current as the size of the buzzer wires will permit. It also enables you to use the grounded side of the mains instead of one which you would otherwise have to make yourself. If your house is not wired, however, as many as a dozen dry cells, or an equivalent storage battery, may be employed. You will have to make two outside grounds for your station by burying a few pipes in the ground.

By providing your key with a third contact, a simple break-in system is obtained. The telephones shown in the receiving circuit are high resistance wireless receivers. In conjunction with all such high resistance telephones, your spark coil should be used as a step-up transformer. That is, the secondary of your coil should be connected with the receivers and the primary with two grounds.

Of course, should you have a good pair of telephones which are of low resistance, you may use them without the spark coil by connecting them directly with the grounds.

Electrical Wizardry at Home

Some weird effects that you can obtain with a Tesla coil and some of your apparatus

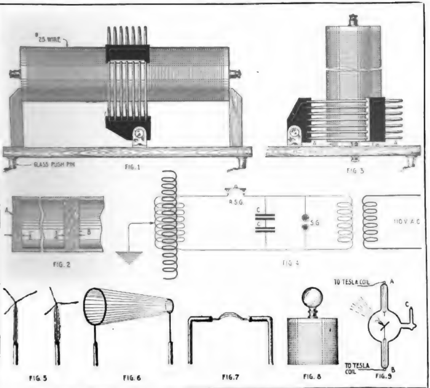
By E. R. Thomas

TO begin with, if you have an oscillation transformer the secondary will make a suitable primary for a Tesla or Oudin Coil.

To construct a Tesla coil that will give a 10 to 12-in. spark, procure a tube 4 in. in diameter and 16 in. long. This may be made of two tubes 8 in. long and joined together as shown in Fig. 2. Some cereals come in tubular containers which will answer very well for this purpose. The pieces *A* and *B* are of wood; shellac is used to join the parts together. Avoid the use of nails in this construction.

After applying two coats of shellac to the secondary tube, wind it closely within ½ in. of either end with double cotton-covered No. 25 wire. Then give two coats of shellac to the windings, being sure the first coat is absolutely dry before applying the second.

The base and uprights should be made of well seasoned wood which should also be shellacked. Make the dimensions to suit the individual requirements. Fasten four glass push-pins to the base as shown



Details in the construction of a Tesla or Oudin coil and diagram of the hook-up for the experiments shown in the lower part of the illustration. These experiments as well as X-ray photographs may be made by the use of this coil

in Fig. 1. These serve as insulators.

In Fig. 3 is shown how the above described Tesla coil with a few alterations can be converted into an Oudin coil. The three small blocks *A* are used to support the secondary.

The hook-up for a Tesla coil is shown in Fig. 4, and the abbreviations used are as follows: R. S. G., rotary spark gap; C and C', condensers; S. G., safety gap.

Various experiments are shown in Figs. 5, 6 and 7. The two wires in Fig. 5 are connected with the binding posts of the secondary and are left to project vertically in the air. Long streamers wave about, producing a weird effect.

The experiment in Fig. 6 produces a cone of light. Two wire hoops, one 12 in. in diameter and the other 3 in. in diameter, are connected with the secondary, and the lead wires are so bent that the hoops are separated 5 or 6 in.

When a gap is made as shown in Fig. 7, a spark 10 to 12 in. is obtained. Of course all these experiments should be made in the dark.

If two metal disks about 1 in. in diameter are provided and one attached to each of the connection leads, a brilliant flow of light will be produced from their edges. For another experiment, suspend two metal rods from the ceiling or other support so that they will hang about 2 in. apart. Connect these to the leads. Sparks will start at the bottom and run to the top, making a ladder of light.

When the coil is converted into an Oudin coil the bottom binding post is connected with the lower turn of the primary; otherwise the connections are the same as for the Tesla coil, as shown in Fig. 4. A brass ball 2 in. in diameter, Fig. 8, should be screwed on the top binding post of the secondary in place of the thumbnut. [illegible] obtained from [illegible]

An intere[illegible] experi[illegible] X-ra[illegible] [illegible] graph, load a plate holder with one plate only, then expose it, holding your hand or other object against the side of the plate holder nearest the plate. The X-rays penetrate the light-proof slide with ease. The time of exposure can only be determined by trial. A good printing negative can be made by holding the plate holder 5 in. from a 6-in. tube and exposing it for 2 minutes.

An Electric Torch Made of Bichromate Solution in a Bottle

ONE of the most novel of the many electric torches recently invented, consists merely of a wide-mouthed bottle having rods of zinc and carbon inserted through a rubber cork. These rods project down into the bottle for about one-third of its depth. On top of the cork a small electric lamp is mounted, similar to those used in ordinary electric torches. Connections are made between the lamp and the zinc and carbon rods.

A mixture of water, bichromate of potash, and sulphuric acid is put into the bottle, and stands at a level of about 1 in. below the end of the zinc and carbon rods when the bottle is upright. When the bottle is turned upside-down, it becomes what is known as a bichromate cell, a well-known type of cell for producing small quantities of electricity for electric bells and similar devices. The electric current produced when the solution surrounds the zinc and carbon rods is strong enough to light up the lamp, and the apparatus becomes an electric torch. The cork of the bottle must, of course, be made perfectly water-tight.

Square bottles with large round mouths, such as are used for pickles and similar products, are very suitable for these torches, as they can be laid down on their sides when light is required.

Lacing Belts Through Eyeleted Holes in the Leather

The life of a belt may be lengthened considerably, if instead of the customary slits in the belt, eyelets obtained from old shoes are substituted through which to pass the thong in lacing. These will prevent the thong from tearing out under the strain when drawn tight.

Wireless Work in Wartime

VI.—Atmospheric or static interference, and how to secure practice in operating through it

By John L. Hogan, Jr.

WHEN the student has learned to send and receive correctly, and has had sufficient practice in reading wireless messages through artificial "station" interference, he is ready to take up the most important (and perhaps most difficult) problem that confronts the radio operator. This is the copying of received messages in spite of the interfering sounds produced by natural electrical disturbances, and called "static," "atmospherics," "X's" or "strays."

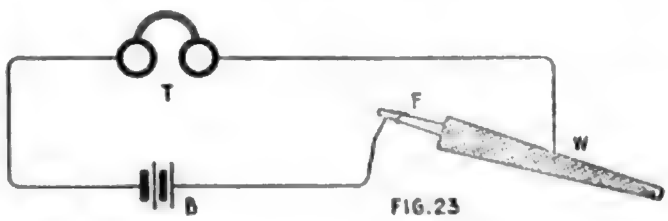
The December article described simple ways to practice reading messages when interfering sounds corresponding to undesired signals from some external radio station are heard. The four earlier instalments of this series outlined the work necessary to learn the Morse code and the sending and receiving of messages. This article takes up the study of atmospheric interference, its effects, and the reduction of harmful results from it.

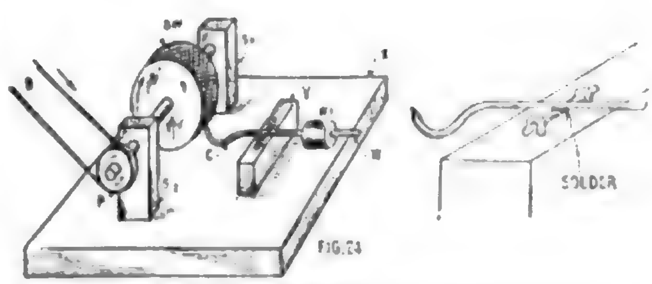
In the first place, we must examine the differences between strays and signals. These differences are, fortunately, usually well defined. First we shall consider the very practical distinction depending upon the fact that strays or static in general produce irregular noises at the receiver, while radio signals may be made to produce musical tones.

In the December article it was pointed out that practice enabled the receiving operator to distinguish between the signals heard from two stations, so that messages from one of them could be written out even though both were sending at the same time. The more skilful the receiving operator, the more closely he is able to concentrate, and the nearer alike the two signal sounds may be without producing interference. The two distinctions usually relied upon are pitch and intensity: if the signal tones are equally strong, there must usually be a considerable difference in their pitch or frequency if one is to be read "through" the other. If the interfering signal is much weaker than that from the communicating station, not so great a difference in pitch is necessary in order that the receiving operator may concentrate upon the desired dots and dashes.

Static Noises and Signal Tones

As has been indicated, since strays usually set up irregular noises rather than tones at the receiver, the operator there is usually able to concentrate upon the messages he wants to receive and to ignore the interference because of the difference in sound. Static sounds are of various





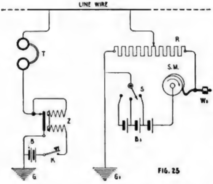
Simple method of producing a static and a more elaborate model for obtaining same results

kinds; they have been described as hissy, scratchy, or rattly, and as resembling frying or bubbling noises. They vary in character from time to time, and are often much louder than the signals it is desired to receive. Static sounds are almost never musical in character, in even the smallest degree. Since the signals from radio stations may be made either musical or non-musical (as has been known for some years), and of almost any pitch, it follows that by choosing clear musical tones the difficulties of reading messages through static noises are largely over-

come. It has also been demonstrated that the best signal-tone frequency for working through static interference is about 1000 per second, which is in the neighborhood of the second C above middle C on the musical scale. This frequency of 1000 has now been selected as standard for nearly all radio transmitters.

An Artificial Static Producer

It follows, then, that to get practice in reading signals through static we must have (in addition to the buzzers which produce the Morse signals themselves) some device which will imitate the sounds of static. The simplest way in which an



One way to associate the buzzer telegraph line and the stray-maker for practice work

idea of atmospherics can be secured is shown in Fig. 23, where a telephone receiver *T* is connected in series with a battery *B* and a coarse file *F*. The loose end of the wire from the telephone receiver, *W*, may be rubbed along the rough surface of the file. The telephone will reproduce irregular rough and scratchy noises corresponding closely to some types of strays.

The file arrangement is scarcely uniform enough in action to use for regular practice, and so it will be well to make up a "static producer" or "stray maker" of the sort shown in Fig. 24. A wooden base *X* has mounted upon it a block *Y* and two drilled standards, S^1 and S^2. These standards support a shaft upon which is fastened a brass disk or wheel *BW*, about ½ in. thick and 3 in. in diameter. One end of the shaft carries a pulley *P* which permits the disk to be rotated *slowly* by belt *B*, a clockwork or back-geared motor being used as a source of power. The circumferential surface of the disk is roughened by cutting irregular diagonal V's across it with a sharp saw-file, so that its surface somewhat resembles an exceedingly coarse and rasp-like file. On the block *Y* is pivoted a soft copper wire *W*, about No. 12 in size, one end of which is bent up to rub upon the surface of the roughened disk at the contact point *C*. The other end of the wire extends out away from the disk, and a small lead weight W^1 is fastened upon it so that the pressure of contact at *C* may be varied by sliding the weight back and forth along the wire.

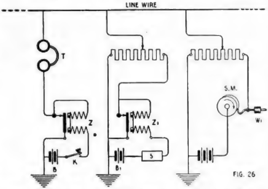
If the terminals of the battery and telephone in Fig. 23 are connected with the disk and the wire of Fig. 24, so that the three elements are in simple series connection, and if the disk is then slowly turned, the telephone will produce sounds like those set up by static. By varying the speed of rotation (which must always be slow—not more than about one revolution per second) and by changing the number of dry cells in the battery, almost any type of static can be imitated.

Connecting the Stray-Maker with the Telegraph Line

Now arrange the stray-maker in such a way that its imitation static can be impressed upon the buzzer telegraph line previously described. Thus, one static producer will afford practice to all the students using the line, and practice can be had in the actual exchange of messages under various conditions of atmospheric interference.

Fig. 25 shows one way of associating the buzzer telegraph line and the stray-maker *SM*. The left-hand portion of the figure represents any one of the stations along the line, and comprises the telephone *T*, the buzzer *Z*, the battery *B*, the key *K* and the ground connection which have been described in earlier articles. At any one of these stations (though preferably one near the middle of the line) the stray-maker may be installed by connecting it as shown in the right-hand part of Fig. 25. *R* is a resistance of about

1000 ohms, with a sliding contact, such as was shown at R^2 of Fig. 18 in the December article. This is connected in series with the battery B^1 and the rotating disk *SM*. The number of cells of battery can conveniently be varied by using a three-point switch as shown at *S*. One end of the resistance unit is connected with the ground at G^1 (which may be the same connection as used for the telegraph station at *G*), and the sliding contact is connected with the line wire. The roughened wheel is slowly revolved, by use of the clockwork or motor as explained above. When the battery is turned on, the imitation static will be heard in all the telephone receivers along the line. By sliding the movable contact of the resistance toward the left or grounded end, the static sounds are made weaker. By increasing the amount of resistance between the line wire and ground connections, the noises are strengthened. It may sometimes be necessary to use more than three cells of battery, but this can only be determined for any particular buzzer telegraph line by actual trial.



Connections for reading through both station and static interferences. They are obtained by combining apparatus

Comprehensive Telegraph Practice

Having set up a buzzer line with at least two other students, and having made both the extra buzzer (with automatic sender) for imitating station interference and the stray-maker for imitating atmospherics, the student is ready to work out a course of practice-study which will fit him for the Morse telegraphing part of the most difficult operating positions. Sufficient plain code practice, without interference, should first be carried on. When there is no difficulty experienced in sending and receiving messages sent at the rate of twenty-five words (one hundred and twenty-five letters) per minute, the next necessary step to be taken is copying weak signals. By using the shunting resistance connected across the telephones, the signals are gradually reduced in intensity, and practice is continued until it becomes easy to read messages so extremely faint that the noise of a rattling window or of someone talking in the room makes it impossible to hear them clearly. This corresponds to the practical radio case of receiving messages from a great distance.

Having perfected one's self in reading weak signals, copying messages at various tone-frequencies should be tried. The article immediately preceding this in the series showed how to adjust the tone frequency of the buzzer. By following the plan given, as well as by using various types of buzzers, signal sounds ranging all the way from a low rattle to a high, piercing musical note may be produced. The expert operator is able to read messages sent with tones of any sort, and it is a good plan to practice on many different frequencies and with both loud and weak signals.

Drill in Overcoming Station Interference

The matter of station interference should next be taken up for drill. Using the automatic sender to produce interference over the entire line, one student should send cipher messages consisting of five-letter words such as QSBVH MKUIL SHDYJ WUIPO. The station sending should transmit a certain number of messages of this sort, the cipher words having been written out in advance, and all the other stations on the line should attempt to copy the signals through the

artificial interference produced by the extra buzzer and sending machine. There will thus be a race to see who can get the greatest number of words correctly, as can be determined by comparing the sent and received copies at some later time. To make things fair for all the stations along the line, the sending should be done from the station at which the interfering buzzer is located; otherwise the ratio of intensity of interfering and desired signals will be different at the different stations. Sometimes it will be found that the same mistake is apparently made by several receiving operators. When this occurs, it is nearly always safe to assume that the sending student has made an error. Thus practice of this sort is seen to be helpful in developing accurate sending as well as the ability to receive through interference.

The first station-interference practice should be made with the extra (interfering) buzzer adjusted to a pitch different from that on which the desired messages are transmitted. Likewise, for the first trials, the interfering signals should be made comparatively weak. When messages are received correctly under these conditions, the interfering signals are made stronger and stronger, until they are about as loud as or even louder than those which are being copied. After this point of skill in receiving is reached, the interfering buzzer may be adjusted until its tone approaches more closely that of the station sending messages. Work of this sort is most valuable in preparing the student to meet the actual difficulties of radio operating.

Practice in Reading Through Strays

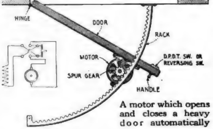
The next step is to practice in reading through static or atmospheric interference. Here the same plan is followed, except that the static-maker is substituted for the extra interfering buzzer. By sending code messages while the stray-maker is working, the strength of the interference is increased day by day until it is possible to receive messages correctly through severe disturbing noises. In this practice the desirability of using a high, clear signal-tone should be noted. Although the low tones sound much louder when no static interference is present, it is surprising to note that the higher and weaker signal tones stand out more clearly as soon as the static begins to grow strong. With practice, the student will find that he can read a high, clear musical signal through disturbing static noises many times louder than the messages. This is one of the most curious phenomena which is encountered in practical radio telegraphy, and explains the selection of 1000 per second frequency for most modern radio stations.

Practice in reading through both station and static interferences may be secured by combining Figs. 18 and 25, as shown in Fig. 26. Here the sending operator manipulates key K, while interfering signals are produced from buzzer Z^1 and atmospheric interference is set up by the disk SM. With the skill which can be attained by faithfully practicing in accordance with the plan outlined above, no operator need dread the difficulties of telegraphing which he may encounter in actual work. He needs in addition to this operating ability some measure of knowledge of the radio apparatus itself, and this matter will be taken up in succeeding articles.

(To be continued)

A Small Motor Used to Open Large Doors

LARGE doors like the ones used on garages are difficult to handle, and for this reason I made the attachment



A motor which opens and closes a heavy door automatically

illustrated, which may be operated with a push-button.

I attached a motor of suitable size and power at the top of the door on the inside, its shaft being supplied with a small pinion which meshes into teeth on a segment fastened to the wall or other suitable support.—H. B. PEARSON.

Wanted: Wireless War Tales

Where is the wireless operator? What is he doing?

The Popular Science Monthly wants to publish *true* stories of his deeds. They gave Owen Chick a Silver Model of a U-boat which bore the inscription "A memento of the escape of the San Melito after being shelled for forty minutes." A. S. Mackenzie proved himself a wireless hero when a giant wave ripped off a hatch of his ship and swept back the wireless cabin in a clutter of deck wreckage. There wasn't anything left of his wireless apparatus but a mass of junk. But he got his set going and saved the ship in a crisis.

We want to tell the stories of wireless heroes, to show how brave radio operators did their bit in an hour of peril—either sending out messages under a storm of shot and shell or making ingenious repairs, as brave Mackenzie did, when human life itself depended on a radio call pulsating through the ether.

We will pay for these true stories.

Send them in as quickly as you can. If you are a wireless operator yourself and it is your own account of what happened to you, so much the better. Don't be afraid to write. We want the facts. If a diagram is necessary, send it with your story. It will be welcome.

EDITOR OF THE POPULAR SCIENCE MONTHLY.

The Metal Apron Saves a Torpedoed Ship

Not a porch shade to keep out the sun, but a remarkable contrivance for keeping out the water after a vessel has been torpedoed. When a great hole is torn in a ship's hull, the metal apron carried on deck on a small wheeled carriage is unfolded like a carpet and lowered over the side. A flexible rubber or canvas pipe on the apron prevents the water from rushing in around the edges

Popular Science Monthly

225 West Thirty-ninth Street, New York City

Vol. 92
No. 2

February, 1918

$1.50
Annually

Plugging a Torpedoed Ship

When a hole is torn in the hull, the apron is unrolled like a carpet and lowered over the side

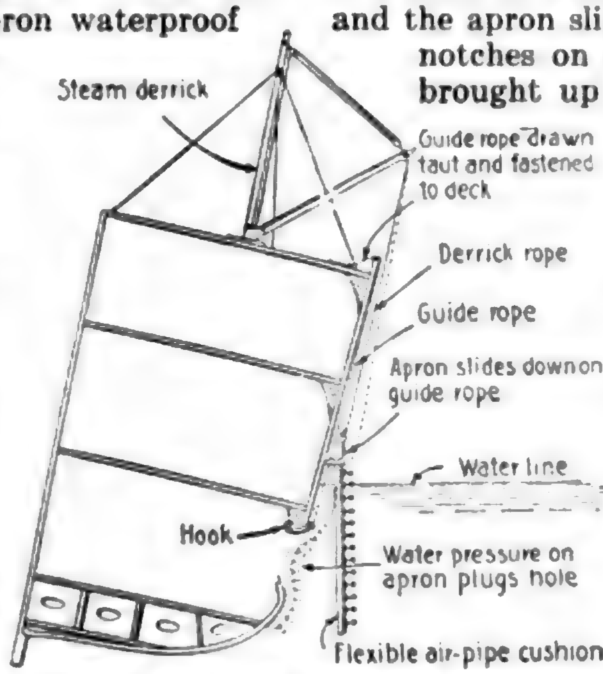
How many ships could be saved for the world's commerce if there were means immediately available to plug ugly holes in their hulls, caused by torpedoes, mines, explosive shells and collisions? This is the question which confronted a Wisconsin inventor and he straightway set about to answer it by inventing a metal apron which can be rolled up and carried on the ship's deck and immediately lowered to plug a hole torn in the hull.

The apron consists of a series of bulb tee irons such as are used for deck beams in ships or as a part of the steel framework in large buildings. The irons are held together by means of flexible metal strips bolted to their flanges. Between the metal strips and the angle flanges are strips of heavy tar paper or rubber compound, to make the apron waterproof when it is placed over the hole.

The flexible metal strips which hold the bulbs together permit the entire apron to be rolled up like a carpet and to be carried on the ship's deck on a small wheeled carriage. When a hole is stove in the ship's side, the apron is rolled to the nearest derrick, which may be the mast boom or a small steam winch placed along the side for the purpose. The apron is unrolled and lowered into the water and down to the hole, where the inrushing water sucks it into contact with the hull. A flexible rubber or canvas pipe about eight inches in diameter is attached to the side of the apron. It comes into contact with the ship's hull and extends clear around the contour of the apron. This pipe is filled with air pumped from machinery on board, so that the apron fits the side of a ragged hole so snugly that water can not rush in around the edges.

To locate the hole in the side, two heavy hooks are first lowered by hand and caught in the front and rear projecting sides of the hole. A third and heavier hook is then lowered midway between the first two and it is made fast to the top edge of the hole. The guy rope holding this hook is firmly attached to the deck and the apron slides down the rope until notches on the supporting sling are brought up against similar notches in the upper end of the hook bar. When these notches meet, the apron's downward course is halted directly over the hole and the inrush of the water draws it securely against the hull.

It is doubtful whether the operation would be so simple if the vessel was moving. Moreover, if the hole torn in the hull were of great size, no such plugging device could keep out the water.



Lowering the apron when the damaged ship has a heavy list. The dotted line shows the final position of the apron when it is placed over the hole torn in the hull

An Automobile Accident Which Couldn't Be Avoided

AN automobile accident which caused considerable interest because of its novelty occurred in Quebec recently. A seven-passenger car partly filled with passengers was ferried across a river on a scow operated by the old overhead cable system. As the scow, with its load, approached the shore it was made fast to a stake and the automobile proceeded to run off. Since the bank at this point was steep, the machine moved slowly, but its front wheels had gone only a few feet before the weight of the car, now shifted to the rear wheels, caused the scow to sink by the head. This downward movement caused the stake to be pulled from its position and the next instant the scow was pushed out into the stream.

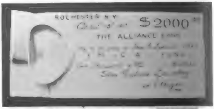
Above: raising the submerged car. At left, how the accident happened

With brakes applied, the chauffeur did his best to arrest the backward movement of the car, but it slowly backed into the river, settling on the bottom under fifteen feet of water. Fortunately, the occupants jumped before the car struck the water. A diver was later sent down to fasten a chain to the front axle, after which the car in spite of its weight was brought to the surface rapidly and with very little difficulty.

A Shirt Worth Two Thousand Dollars

THE head of a laundry in Rochester, New York, a man possessed of imagination as well as of money, recently presented the local Y. M. C. A. with a shirt worth more than its weight in gold. It was nothing but an ordinary, white, stiff bosomed shirt. No costly studs were planted in its buttonholes, but across the front were inscribed words which made it a check for two thousand dollars to go toward the erection of a big, new Y. M. C. A. building.

Perhaps the donor felt that a suspicious public, its temper as well as its clothes frayed from many uncharitable encounters with steam laundries, needed reminding that even a laundry owner may have a heart.



The president of a laundry presented this unique check to a Y. M. C. A. building fund

A Catholic Identification Book for Mortally Wounded Soldiers

THE illustration shows a neatly encased Catholic booklet which is considered especially valuable to all Catholic soldiers. If wounded and in danger of death, the last rites of his Church are an inexpressible comfort to the Catholic soldier. This booklet contains prayers which may be said by a comrade in the Faith, if no priest is within call of the brother in need. A crucifix and a scapular medal, which when blessed, bring the indulgence to those in the shadow of death, are also fastened into the case.

The encased booklet contains prayers for the dying, to be said by a lay Catholic in the absence of a priest

The outer page of the booklet gives the owner's name and address, together with the request to call a priest if the owner is helpless and in danger of passing away. In time of serious accident or other emergency, a booklet of this kind is considered invaluable to all Catholics.

Races in Motion Pictures Employ a "Ben Hur" Revolving Platform

THE great chariot race in the production of "Ben Hur" on the legitimate stage is lending its thrills to the motion pictures nowadays. The revolving platform which made the great scene possible is now being used to give realism to photo-plays in which automobile races or horse and chariot races play an important part.

A drum is carried on the platform. On this drum, scenery is painted to represent the different changes of landscape through which the racers pass. An idea of the size of the drum may be gained by comparing it with the trolley car which is passing along the street behind the drum. The camera-man stands on a permanent platform nearby, which is so placed that he can take a side, front or rear view of the races without shifting his camera or wasting valuable time.

The huge platform is revolved by a powerful motor. The scenes representing the changing landscape are painted on the drum around which the thrilling races take place

Why Monkeys Use Their Fists Instead of Their Hands

WHEN next you go to the zoo, watch the monkeys use their hands. Notice how they seize things with their fists. They do not use their finger-ends as we do. While the higher monkeys, such as gorillas and chimpanzees may be taught to use their fingers, they never learn to use them as easily as do human beings.

The monkey is primarily a tree-dweller. It lives in forests and swings from tree to tree, using its hands as hooks with which it grasps the branches. The thumb is not brought into play. Some South American monkeys have lost the thumb through disuse; all that is left of it is indicated by a little lump under the skin.


An educated chimpanzee threading a needle. His thumb is not well developed

In the higher monkeys the wrist is built like yours. It has the same number of bones. But the monkey has never used his wrist, and so it has lost the flexibility. The monkey can use its feet to better advantage than its hands.

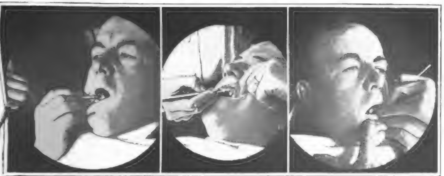
Man, on the other hand, has used his feet so long simply for the purpose of walking, that he would experience considerable difficulty in using them as he uses his hands. Yet, it is amazing how quickly a man can learn to use his toes as he does his fingers. If you don't believe this, just try to write with your toes. At first the letters will be very large and awkward. But with a little practice you will find that you can write with your foot more easily than with your left hand, if you are naturally right-handed. It is an attractive exercise with which to while away an hour. We know you will try the experiment.

Explosives Are Simpler in Composition than They Seem

HERE, gentlest of readers, we have an object lesson in explosives. The inventor of a particularly new and violent kind is throwing it against a tree in demonstration of the fact that it will not "go off" in the absence of the proper kind of primer. It even may be lighted with a match, and it will burn like a pitch torch—but no explosion. But should you attempt to set it off with a certain primer, you will arrive elsewhere with promptness and exceeding dispatch.

Most smokeless powders will admit of similar treatment. These features about explosives seem most unusual, until one looks into the physical principles back of their action. Explosion is simply a burning. The quicker the burning the higher the "high" explosive. If an object burns; i. e., is converted into gas quickly, the expansion resulting is capable of exerting tremendous force on whatever happens to contain the object. Here is the force that drives projectiles such tremendous distances.


Throwing this explosive against a tree will not detonate it; a special primer is necessary



Why need a dentist use both hands? Here the patient is assisting him by holding the mirror and lifting up or pulling down a lip so that he can reach the troublesome tooth

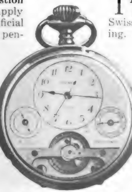
A Chance for the One-Armed Veteran—Let Him Become a Dentist

SOON after the outbreak of the war, Mr. Frank B. Gilbreth, known the world over as an authority on shop management and motion study, went abroad for the purpose of studying the industrial employment of crippled soldiers. Nearly every European government has profited by his investigations. He speedily arrived at the conclusion that while false arms and hands were pleasanter to the sight than mere stumps and while they might even reproduce mechanically with remarkable fidelity the movements of arm and finger muscles, it was far more practicable to adapt the cripple to his work by teaching him how to utilize what members were still left to him. It is out of the question to ask a poor veteran to supply himself with an expensive artificial arm, and it is humiliating to pension him off and let him while away an idle existence in some parsimoniously conducted soldiers' home while he is still in the prime of life.

Accordingly, Mr. Gilbreth has worked out innumerable methods of enabling a man with a single arm to earn a livelihood. In the accompanying illustrations it is shown that a dentist need not use both hands in operating on teeth. Here the patient assists the dentist. He holds the mirror for him or he lifts up or pulls down a lip so that the dentist may reach a tooth. That this is no theory, Mr. Gilbreth has proven by actual experiment. He has had his own teeth filled in the manner shown, not by a one-armed dentist, because there are none, but by one who had one arm tied behind his back and even one eye blindfolded to prove Mr. Gilbreth's point. In a later issue, POPULAR SCIENCE MONTHLY hopes to take up these investigations of Mr. Gilbreth's more extensively.

An Eight-Day Watch Tells the Date and the Day of the Week

THE accompanying illustration gives another example of Swiss ingenuity in watchmaking. The watch is little larger than those of standard American size. Yet by coiling the thin spring around the interior wall of the case, sufficient energy is stored in it to run the mechanism for eight days. By adding several more gear arrangements to the watch, two extra hands are provided which point out the day of the week and even the day of the month.



A watch that needs winding only once in every eight days

How Man Makes Rope and

Photos © Int. Film Serv.

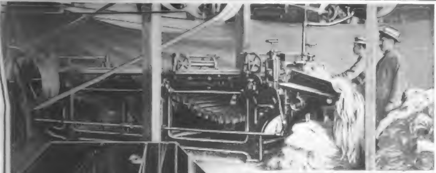
The plant that Don Juan, here, is holding, will eventually become part of a rope. Sisal and Manilla fiber make our rope and twine

A bag of fiber being made into rope right on the plantation. Note the old-fashioned wooden spindles these rope makers are using

After the fiber has been dried and combed, these men pick it up, a few strands at a time, and separate it to keep it from sticking together

Rope workers busy on a tropical rope plantation. The long strands of rope are stretched over forked stakes that they may be thoroughly dried and bleached by the hot sunlight

Twine by Hand and by Machine



Before the fiber can be spun into twine, it must be thoroughly combed. An up-to-the-minute machine takes the seemingly hopeless tangles out in no time

When the fiber arrives at the factory, it is stored in big warehouses, as shown below, until it is fed to the machines which convert it into twine

Those nicely wound balls of twine which you find so useful are made by the clever machines you see in this photograph

The fluffy strands of fiber being run through spreading machines which must prepare it **carefully before it is** ready for the spinning machines. Note the length of the strands

Jonah's Miraculous Gourd Was Not More Wonderful Than These Which Grow on a Farm in New Jersey

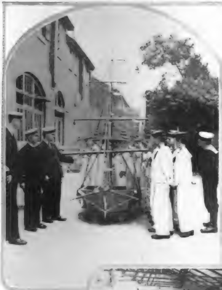
A sugar bowl and spoons made from "dipper gourds." By careful crossing of varieties the resultant vines are made to produce strange fruit

These fortunate small boys needed no expensive baseball equipment. Their bat and balls were picked from the gourd vines

Smoking set, lamp, and gourd on which guests register. All these photographs were taken on Mr. E. E. Wilcox's large New Jersey farm

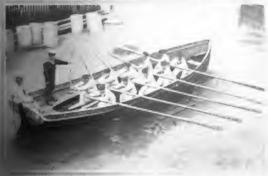
A gourd labyrinth resembles a strange gymnasium with growing dumb bells, Indian clubs and punching bags. Gourds, although planted in the same way, should not be grown near squashes, watermelons, cucumbers or pumpkins, because useless crosses result

English Jackies Go to School Too



British boys in training for the navy, at Shotley barracks, England. Instruction in seamanship by use of a model sailing vessel of good size is being given

Flag signaling is important in the training of the British Jackie. He must be able to read the messages sent, quickly and accurately, or trouble results



Above, at right: Instruction in gunnery practice with aid of actual guns. Boys learn all details of sighting, loading, and firing—rapidly becoming experts

Young tars receiving their first lesson in oarsmanship. They learn rapidly, as boating is an exceedingly old sport among the sea-loving English of all classes

Would You Do It for a Living?

Equipped with a syringe of "germ killer," this man sprays the places where Chicagoians seem to be fondest of expectorating

Photos © Int. Film Serv.

A Chef to Bacteria. Miss Agnes Quirk caters to the dangerous bacteria used in the interesting research work at the Bureau of Plant Pathology in Washington, D. C.

This young man, employed by a Brooklyn
He illustrates the becomingness of various

Would You Do It for a Living?

Photos © Int. Film Serv

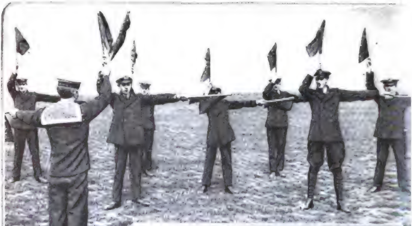
A doctor with ten million patients. Miss Rose Murray is swathed in this way to guard **against inhaling bacteria while she ministers to torn, backless and otherwise mutilated books in the New York public library**

A Daredevil of the Clouds. This perilous trapeze performance is all in the day's work. The performer says he enjoys his job because it keeps him out of doors

[illegible] Miss[illegible] Merrifield, of [illegible] Barre, Pa., earns his [illegible] with the efficient [illegible] needle

Wouldn't you rather be "on the outside, looking in?" This daring young assistant at the Central Park Zoo is employed as dentist to Miss Murphy, the hippopotamus

Reading Flag Signals from the Sky



The airplanes which accompany fleets must take orders from the ships. Wireless receiving is not yet practical. Hence the importance of flag signals. Above: British aerial apprentices being grounded in the flag language

Photos © Underwood and Underwood

A more advanced class. The officer sets a flag signal on the model of a ship's rigging. The students reply to it by moving their miniature squadrons. This exercise is also an excellent training in quick tactical judgment

Students must identify from a distance the models of friendly and hostile ships which are placed on a table painted to represent distance at sea. The hinged board at the back is raised to represent a seemingly vertical background of sky

How Her Jeweled Comb Is Made

Placing tiny jewels in tortoise shell combs. The girl who does this tedious work is called a "placer." The jewels are so small tha* she cannot handle them with her fingers, so she uses tweezers. The stones must be heated on an electric stove before they can be placed

The electrically heated stones are cemented into the settings prepared for them. This process insures their sticking. Great care must be exercised to prevent the cement from showing. Only the minutest amount can be used. The patterns usually are exceedingly intricate

Drilling the tiny settings for the stones which make the elaborate patterns on the present day jeweled combs. The drill is operated by electricity

This man is working on an aluminum comb. After the brilliants are firmly set, he takes a sharp tool and carves the metal around the jewels

Photos © Press Illus. Serv.

Samples of elaborately jeweled combs and hair ornaments. What young lady would not linger over such an attractive display in one of the shops

The Germans are Coming! Sound Bombs Soar

Photos © Int. Film Serv.

When air raiders approach London warning is now given by sound bombs which rise three hundred feet before exploding. Above is shown the mortar which is used for firing the rockets. They get results

Inserting the time fuse in a rocket before sending it aloft. The bombs produce a tremendous noise which can be heard over great areas. London has come to know this helpful "run to cover" signal

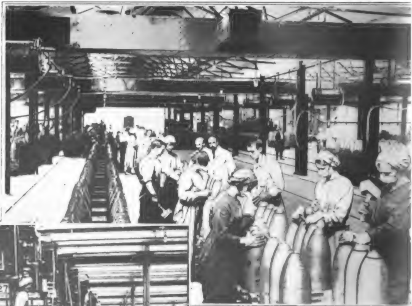
Into the Air to Warn London of Air Raids

Putting the bomb, or rocket in the mortar. As is evident, the mechanism for firing is simple. It can quickly be mounted on the top of a wall or on a convenient roof

Fire! The operator simply pulls a lanyard attached to the fuse and away goes the bomb high over the city. When many bombs are exploding the noise is deafening

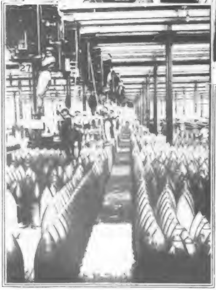
Cleaning out the mortar after firing. Since the mortar is short, this is not difficult. London plans to have smoke bombs for use during the day, so that smoke clouds as well as loud detonations may warn the people

England's Heroines Are in Her Munition Plan



Photos © Underwood and Underwood

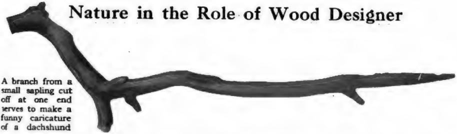
Dressed in the familiar garb of the muni tions maker and wearing masks to protect their nostrils from the noxious fumes of high explosives, these workers are putting the finishing touches on large shells



Below are shown shells of eight different sizes which England is using against her enemies. A steel ring is placed in the nose of each shell. By means of this, the shell can easily be lifted with an ordinary hoist

Crane girls in one of England's greatest munition plants swinging to the floor from their aerial posts, where they operate a vast network of hoisting machinery. More than eighty thousand British women are now holding positions occupied by men before war altered industrial conditions

Nature in the Role of Wood Designer



A branch from a small sapling cut off at one end serves to make a funny caricature of a dachshund

A knothole in a section of pine board resembles a death's head. It is only one of many curious instances of Nature's unconsious modeling

This well chiseled ear is the work of time and the elements. The lines of the lobe and sound opening are almost perfect

Turn the page sideways and the bit of twig at the right will resemble the crawling figure of a human being

A wooden snake. When found it was of a brown color with well defined markings of green. The alert, vital poise of head and tail are particularly lifelike

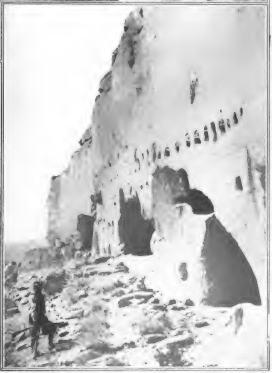
Photos © Brown & Dawson

[illegible] of the Cliff Dwellers, in Mesa Verde National Park, in southwestern Colorado. [illegible] largest of the prehistoric ruins on the Mesa. The ruins are three hundred feet [illegible] contain about two hundred rooms, including twenty-two kivas, or underground [illegible] chambers. Several of these may be plainly distinguished in the photograph

the Cliff Dwellings of Our Prehistoric Ancestors?

Photos © Brown & Dawson

A cliff dweller's house. Discoveries in this region have been remarkable. Two brothers out hunting stray cattle, once penetrated through dense scrub to a cañon's edge. There, in the opposite cliff before their astonished eyes, lay a whole city. The dry air had preserved it well through the thousands of years



What remains of the large village of Puye, in the Frijoles Canon, in New Mexico. This is one of the most interesting and picturesquely located of the many prehistoric ruins on the Mesa (plateau). The small holes supported timbers used for porches. The region roundabout abounds in curios

Making Isinglass from the Swimming Bladder Used to Clarify Wine and Beer, to Make China

Drying the Bladders

Sounds from hake being dried before they are converted into isinglass. The sounds are the swimming bladders of the fish. They regulate its weight so that it can maintain its position at whatever water level it chooses. One ton of hake will yield from 300 to 500 sounds weighing from 40 to 50 pounds.

From Bladder to Isinglass

Rolling hake sounds for isinglass. The dried sounds are softened by soaking them in water. They are then cut into [illegible] pieces. The material is [illegible] again and run between [illegible] rollers. It is then passed through hollow, water-cooled [illegible] and comes out in sheets. [illegible] the sheets are passed [illegible] small ribbon rollers.

# of Fishes. This Product of the Hake Is Cement and to Provide Court-Plaster Adhesive

Ribbons of Isinglass

This is not a picture of spring housecleaning. It is the drying room of an isinglass factory. The ribbons are dried in a few hours by being hung in a moderately warm, light room. The ribbons are carried in baskets into the drying room where they are hung up by women. When dry they are wound into coils weighing less than a pound. One fifth of the original weight of the sounds is lost during the complicated process of turning them into commercial isinglass.

Uses of Isinglass

Winding the dried ribbon isinglass on a wooden spool. One ounce of isinglass will clarify 200 to 500 gallons of wine and one pound will clarify 100 to 500 barrels of beer. It is also used for making cement for repairing glass and pottery, for the adhesive in court-plaster and as a dressing for textiles, which imparts luster and stiffness to linens and silks. In combination with other substances it is used to make india ink and to waterproof fabrics.

Taking Old Dobbin to the Dentist

Horse-dentistry is not one of the overcrowded professions. It is not a calling for weaklings

If a horse has lost a tooth in one jaw, the one opposite grows very long because nothing grinds it off. The dentist trims off long teeth with the nippers

Horses as a rule prove themselves docile. Here the operator is spraying out the horse's mouth in order to prevent the formation of cavities

PHILADELPHIA has a dental office for horses. You, or rather the horse in company with you, enter the office through a special doorway and are ushered into the waiting room. Here you may rest and improve your mind with the out-of-date literature usually found in dental establishments, while your equine friend is taken to an operating room in the back.

The operating department consists of a number of stalls, well padded and carpeted with hay, so that the horse runs no risk of injury should he rear during the investigation of his dental equipment. First, he is fastened securely by straps running from both sides of the stable to his head and also from the roof of the stall, so that he cannot move his head sideways or up and down. The straps are connected with a heavy rubber harness that slips loosely over the jaws of the horse.

Not being gifted with the power of speech, the horse cannot tell the dentist which particular tooth is troublesome. It is therefore necessary for the dentist to locate the aching tooth for himself. This is not so difficult as it may seem. The dentist locates the troublesome tooth either by the presence of an abscess or, if there is none, by means of an implement called a "float." With the float, which is but a long-handled file, the dentist feels along the teeth until his sense of touch tells him he is in contact with a loose tooth. That is the tooth to be removed. Extraction is about the only remedy when a horse has the toothache. There is no such thing possible as filling a horse's decayed tooth.

The horse, suspicious and nervous as soon as he feels the gripping forceps, involuntarily helps the operation by flinging up his head. He almost pulls the tooth himself. The difficult part of the operation for the dentist is to hold the tooth firmly in the forceps and help with a counter pull. Most of the dental trouble of a horse occurs with the upper teeth so that it is seldom necessary to extract a lower one.

All the specialized knowledge and information of the editorial staff of the Popular Science Monthly is at your disposal. Write to the editor if you think he can help you.

How Floating Particles of Dust Cause a Fire

SPONTANEOUS combustion is caused, so the chemists tell us, by floating particles of coal dust or other inflammable material jostling and clashing against one another until the friction they set up raises their temperature to the ignition point. If this explanation is correct, it would appear as if such fires could be prevented by perfect ventilation. Such, however, is not the case, for ventilation may actually help to bring about fire by spontaneous combustion. Air facilitates oxidation, really fanning the warm dust into a blaze. Keep air damp and quiet to avoid fire.

A Clock with Works Encased in a Huge Log

EVERYBODY stops to look at a clock in the offices of the Manufacturer's Association, in Seattle. It is a curious time-piece, the works of which are encased in a hollowed section of a Douglas fir log, probably more than two hundred and twenty-five years old. The section of the log serves admirably as a dial for the clock, the numerals, showing plainly

The appearance of the clock is not its only claim to distinction. Its size also warrants more than ordinary interest. The dial of the clock is more than three and one-half feet in diameter and the minute hand more than four feet in length.

The clock works are contained in the hollowed section of a fir log more than two hundred and twenty-five years old

The palace was constructed of ice blocks cut and laid like blocks of stone

The cannon were also made of ice and were strong enough to fire off charges of real gunpowder

Guns of Ice That Fired Real Powder

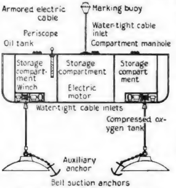
MORE than one hundred and seventy-five years ago some ingenious Russian workmen conceived the idea of constructing a building of solid ice in the city of St. Petersburg, now Petrograd. They erected the structure shown in the accompanying illustration. It was fifty feet long, sixteen feet wide and twenty feet high. Before the palace, they placed six cannon of the six-pounder size, and these too were made entirely of ice. They were turned on a lathe. The cannon were more than ornaments. They could and did shoot actual charges of powder. Although the bore of the barrel was only four inches, the ice was sufficiently strong to withstand the force of an explosion of nearly two thousand grains of powder.

Supplying Submarines by Trailer

Carrying fuel and supplies in a tender, a submarine is made lighter and more mobile

AUTOMOBILES have trailers, motor trucks have trailers—why not submarines? Apparently acting on such an idea, Philippo L. E. del Fungo-Giera, of New York city, has patented a tender or trailer which submarines may frisk over the high seas as unconcernedly as a farmer hauls his milk cans in a two-wheeled vehicle behind his Ford.

The tender, which is about thirty feet long, can be submerged a convenient distance from the field of operation and thus concealed from the enemy. In it, fuel supplies, compressed oxygen, oil and other stores are carried. When the submarine runs out of such necessaries it can return to the tender and renew its store. The frequent long trips to and from a naval base are largely eliminated.



Cross-section of the tender, showing the storage compartments and apparatus used

Of interest about an invention of this kind is the fact that while the Allies might use it, it is improbable that the Germans could. The North Sea is patrolled by several thousand submarine-chasers of various types for which reason it seems unlikely that the Germans could use the idea.

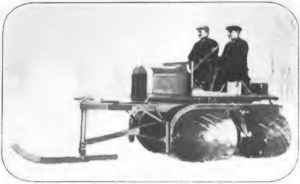
Upon approaching the scene of action the submarine vessel would attempt to reach shallow [illegible] if possible. There she would [illegible] anchor the tender. F[illegible] an armored cable conne[illegible] machinery within [illegible] controlling mechan[illegible] buoy above. Th[illegible] of the buoy, [illegible] is connected [illegible]amos, and turn [illegible]chor cables are [illegible] motors drive [illegible]artially wind up [illegible]. The tender is thus made to sink to the desired depth, while the buoy cables automatically pay out a corresponding amount. After concealing the marking buoy with seaweed, observations are taken to determine its position, and the submarine proceeds upon its way.

Allied submarines which operate in the Baltic sea, perhaps a thousand miles from their naval bases, ordinarily have to spend a week's time in traveling to the scene of action and returning. Fuel and provisions are used up so rapidly that the submarines have little more than a week and a half in which to raid Germany's ships. However, advocates of the new invention believe tenders are capable of improving this situation. While pulling a trailer may slow up a submarine's progress to and from bases somewhat, this is made up for by the longer time the store of supplies brought along permits the craft to stay at sea. It would clearly be out of the question to haul supply tanks through the North Sea, around the north of Scotland, and to plant them in the Atlantic Ocean itself.

Obtaining supplies from the tender is accomplished by first manipulating the anchor cables in such a way that the craft may rise to the surface. Then one of the crew opens and enters a manhole, afterward taking out through this opening any package stores the submarine may desire. The stored oxygen, which is used for breathing when the submarine travels under water, is discharged into the submarine by means of suitable hose connections. The oils are likewise pumped across through hose. A man may be left permanently on the tender to lower it still farther if in danger.

There's Food and Drink and Fuel in the Tank

The submarine is about to return to its tender to take on needed stores. The crew simply lassoes the floating buoy, connects an electric cable, and by means of a control mechanism inside the submarine, causes motors within the tender to unwind the anchor cables and allow them to come to the surface. A member of the crew then scrambles over to the tender, opens a hatch, and takes out any package stores desired. Oil and fuel are transferred by pumping them through a hose. The oxygen is also piped across. If desired, a man may be left on the trailer permanently, to raise or lower it by means of hand winches when necessary



The four sheet-iron drums revolve sidewise but the auto sled goes forward. The long runner in front is for steering

Skating Over Ice and Snow in a Queer Motor Sled

MOTOR sleighs have not yet been perfected, although there is a genuine demand for them in northern countries. It is difficult to get traction on rough ice or in loose and deep snow. But sideslip of the vehicle is the most obstinate source of trouble, and the control on hills, whether going up or down, is precarious. Safe steering depends greatly on the driver's sharp eye and caution. For a tractor intended to haul loads over ice and snow, these difficulties are much aggravated, unless the speed can be very low; yet such a tractor has been invented and built by Frederick K. Burch, of Grand Rapids, Mich.

Clum[illegible] mil[illegible] wh[illegible] In [illegible] is [illegible] the middle, four sheet-iron drums, which also support the vehicle, are rotated: those on the right side to the left (seen from above) and the pair on the left side to the right, as if meant to scrape the road from under the middle to both sides. The drums are rounded in front to rise easily over rough spots and to facilitate steering. They carry curved (helical) channel-iron ribs which grip the ground against sideslip as well as for traction. This driving principle was tried on a motor sleigh at Chamonix, near Geneva, Switzerland, several years ago, but with only two relatively small ribbed drums held against the ground by springs, as the main load was supported on runners.

A Whale Which Strains Its Food Through Whiskers

ALL whales develop rudimentary teeth before birth. If the teeth continue to grow, the whale is put in the toothed class; if the teeth are displaced by a large number of flattened plates of bone or baleen, fringed at the edges, the whale is put in the whalebone class. Baleen forms a sieve through which the whale strains all food col[illegible]er. The three men [illegible]ation are reclining in [illegible], directly against the [illegible]ks like a polar bear's [illegible]ing but that, for what is really shredded bone.

The Steel-Plated, Helmeted Knight of the Trenches

BACK in the Middle Ages the doughty warriors went to battle fully armored. In times of impending danger, the knight's squire must have spent about a half day getting his master into his trappings.

Beside the exhibit of ancient armor stands a modern British Tommy. He too, is steel-plated. And thus does progress move in circles. For armor is coming back into use again.

At all times the wearing of armor is limited by three principal conditions; the weight of the type available, the kind of weapons and ammunition in use by the enemy, and the degree of movement expected of a soldier. If the weight is too great, the soldier soon tires; if the enemy is using high-powered guns at close range, armor is of little use; and if a soldier must run about, steel appendages are in the way.

Steel helmet and chest-covering of the modern British soldier on left make him resemble knight in armor of old (right)

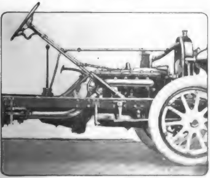
Use Your Hot Radiator Water to Keep Your Steering-Wheel Warm

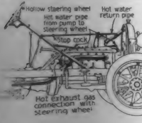
THE happy idea of utilizing the boiling water in the automobile radiator and the red-hot gases from the engine for keeping the driver's feet warm, has already been presented in the POPULAR SCIENCE MONTHLY.

Charles C. Walker, of Utah, has now finished this job by devising an arrangement for similarly warming the chauffeur's hands.

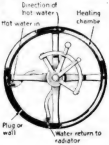
The hollow interior of the steering wheel is connected across a part of the circulation system of the engine. By means of a pair of valves, the flow of the hot water can be regulated to give a delightful warmth. Hands were meant to be warm and radiator water to be cold. This idea benefits both ways.

If the water is too hot to be controlled easily, the exhaust engine gases can be used.





Warming the steering wheel with water from the radiator tank. At left is shown how the water and the exhaust gases can be utilized for this purpose. At right is shown the wheel arrangement by which the hot water circulates through the rims

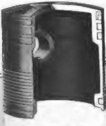


To prevent the bodies of new automobiles from becoming scratched during transit the tipping truck body is now used

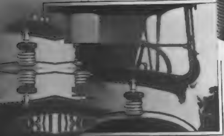
Cabinet or case for the automobile in which lunches, thermos bottles and other camp necessities may be carried

Lamp lens with a visor for directing the light rays downward and to the side through five horizontal prisms which deflect the light below the horizontal

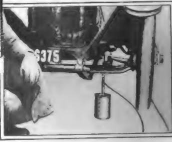
A supplementary spark plug base in which the spark may be examined while the engine is running



Piston ring that has room at the top for the expanding gases when the expansion compels the ring to fit snugly the walls of the cylinder



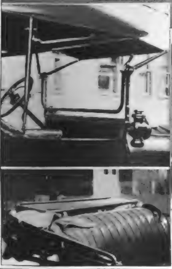
miniature still on a radiator tube to catch and condense alcohol vapors and return liquid to the cooling water



Automobile jack worked by air pressure applied to a piston in a cylinder. The air hose is attached to the piston rod through which it is carried to the cylinder

the Automobile and Its Owner

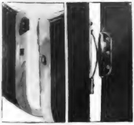
Gasoline engine-driven fire extinguishing appliance mounted on a trailer so that it may be drawn by a hook-and-ladder wagon or other equipment for fighting fire



Automobile visor which extends from the top and folds back with it. When in use, it keeps the rain and sun out of the driver's eyes

Short-handled mop similar to the ordinary household kind for washing the automobile. It has hose connections to run the cleaning water through the short, curved handle

Electric terminal threaded to engage spark plug center-bolt. One motion puts it on the plug or removes it when trouble impends



Rattling automobile doors are silenced by this stiff spring to hold the door tight against its jamb

Goggles that are easily attached to any hat rim or cap visor where they are supported. This lessens the unpleasant pressure on the nose

Extension rims for applying to the rear wheels of an auto truck when it is necessary to drive it through a soft place or on a muddy road where stalling is imminent

At Last the Breakfast Egg Has Broken Into Art

THE Nouveau Art movement has reached San Domingo.

There is a pine tree in front of the thatched domicile occupied by the dusky family immortalized in the accompanying photograph, but even its own mother would not recognize it now. In an effort to express their feeling for Art in its relation to Life, (observe that we use the customary capitals), these natives have decorated the pine needles with the shells of the eggs which they have eaten. The family seems thoroughly satisfied with the striking result.

No wonder there is an egg shortage. San Domingo natives use the shells for decorative purposes

Work the Brake—Quick! Or You'll Hit the Dummy

"APPLY your brakes, man, or you'll hit the dowager crossing the street." Remember when the automobile instructor shouted that command? And remember how you mistook the accelerator for the brake and shot past the fat lady at express train speed?

Such an experience was unnecessary. Study the accompanying picture and you'll be con- ... You ... is the invention of John G. Torr, of Sydney, New South Wales, Australia.

In the car's jacked up position the front wheels may be turned at will and the rear wheels may be revolved by the power of the car engine just as if they were running over the road. A small transverse shaft underneath the rear end of the car is provided with a pulley. over which the belt may run and with two friction drums which may be pushed into contact with the sides of the rear wheels to transmit the power and make the belt run. This is done by means of two small pedals, one on each end of the shaft.

One of these pedals is worked by the instructor so that the belt is set in motion toward the front of the car, carrying with it a life-sized figure of a man by means of a small stop on the belt. If the novice does not apply the brakes in time to prevent the figure from striking the car, by stopping the motion of the belt, the instructor may stop it by throwing the friction drums out of play by releasing the pedal.

If the skill of the novice is not sufficient to prevent the figure from striking the car, the figure is not broken but is simply folded down horizontally on the hinge on which it is mounted so that it can pass on under the car and travel back to the front of the conveyor, ready for the next trial of the novice driver's skill.

A pulley draws the dummy forward. The novice driver strives to stop the automobile before the figure reaches it

Forcing an Automobile Into the Air with a Stream of Water

IT was not until an automobile in Los Angeles ran into a hydrant, breaking it off and sending a column of water shooting up into the air, that some resident motion-picture directors thought of incorporating the idea in one of their thrillers. Had they known that in practically every shooting gallery in the country, one of the most popular targets is a ball suspended at the top of a stream of water, they might have staged the same thing years ago. But even though the idea was a bit old, it served their purpose.

With two poles, a donkey engine, cables, a hydrant and an automobile filled with actors, a stream of water was actually made to give the impression that it was holding up the car in the air. The car was attached to a crosspiece and it was hoisted up and down by the donkey engine. Water from the hydrant just touched the bottom of the car. Of course, the hoisting apparatus did not appear in the picture. All one saw was the frightened occupants in the car shooting up and down on the top of a powerful jet of water.

Showing the donkey engine, and one of the two poles to which the cables were attached

The automobile went up and down like an elevator but the water didn't have the least thing to do with it

Estimating Ship-to-Shore Distances

PROFESSOR J. JOLY, of Dublin, has suggested an ingenious method of measuring distances by wireless. He relies on the fact that disturbances travel with different speeds in different media. Sound travels eleven hundred feet or more a second in air and about forty-seven hundred feet a second in water, while wireless or light signals travel at equal speeds. Thus, if a shore station sends out these different signals at the same time, they will not be received by the ship simultaneously; there will be an interval of time between them that will increase as the distance of the ship from the shore increases. If a mile from the station, a ship would receive a sound signal in air 4.5 seconds later than a sound signal in water, and an air sound 5.5 seconds, or a sound in water 1.2 seconds, later than a wireless signal. Therefore, with a knowledge of the interval which elapses between the reception of any two of these different signals, it is a comparatively simple matter to calculate the source from which they have been sent. Knowledge of arithmetic is all that is necessary.

Faithful women workers learning how to operate a knitting machine which turns out ninety-six pairs of socks daily

Knit, and Let the Red Cross Machine Knit Too

EVEN with the women knitting on every permissible occasion, as well as on many unpermissible ones, the supply of knitted articles for the soldiers already in France and the many thousands in the large cantonments never equals the demand. Socks are especially needed. But, even if the click of knitting needles invades our dreams, and during our waking hours disturbs us at the theater or even at church, the average woman worker, be she ever so assiduous, can produce only one sock a day.

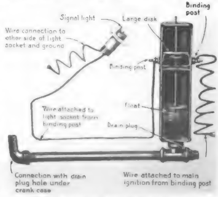
To meet the demand which the hand knitters are unable to supply, the Cincinnati Red Cross has had the first mechanical Red Cross knitter set up in its workroom. This machine turns out one hundred and ninety-two socks, or ninety-six pairs, in an eight hour day. In spite of its complicated appearance, it is comparatively simple to operate and it never drops a stitch.

No Oil? Your Car Will Stop Automatically

IF the engine of an automobile is not properly lubricated, the piston will in mechanical parlance "seize" the cylinder walls. The interior of an engine cylinder is highly polished, and so is the piston that fits within it. Between the piston and the cylinder wall is a clear space of about three-one-thousandths of an inch, which is about the thickness of the paper on which the POPULAR SCIENCE MONTHLY is printed. This minute space is filled with a film of oil. If that film should be destroyed, the piston would become locked to the wall, and an expensive repair bill would show the extent of the damage.

H. M. Dickerson, an automobile mechanic of Evansville, Ind., has invented an automatic device which keeps a check on the oil supply and takes the place of a faulty memory. The driver may be careless and negligent—but not Dickerson's automatic gage.

Within the gage is a float connected by a rod with a small disk above which is a large disk. As the float rises and falls the large and small disks rise and fall with the float. As the oil is consumed, the float descends. When the danger point is reached, the large disk touches the first of two sets of electrical contacts. A warning signal light flashes up on the dash; the driver is told that the oil is low. If the supply is not replenished, the float descends still further. The small disk then touches with the second set of contacts and the engine is automatically stopped before trouble results.



How the engine is automatically stopped when the oil supply becomes too low

Beware of Poultry Which Comes Packed in Barrels

INSIST on buying dry-packed and dry-chilled poultry. When you order poultry which is packed in ice, you are probably paying for from three to fourteen per cent. of water which has been soaked up by the bird. So states a report issued by the Department of Agriculture. This water ruins the flavor and the quality of the meat.

If possible, see the package in which your butcher receives the chickens. High-grade, dry-packed birds are commonly sent to market by the dozen in paper-lined boxes. Wet-packed chickens are shipped in large barrels.

Tent Stoves to Keep Our Soldier Boys Warm in the Training Camps

NO mental pictures this year of our soldiers freezing in their camps. They are made as comfortable as possible, although the stove with which the government provides each tent is not exactly like the big brick fireplace or the ornamental steam radiator at home. It is made of tin, with a jointed pipe to let out the smoke through an opening in the top of the tent.

As the majority of the camps have purposely been located in sections of the country where the winters are mild, this heating device should prove adequate.

Burning wood as it does, fuel may be had at any groves or wood lots which happen to be near the soldiers' camps.

© Press Illus. Serv.

In our training camps, each tent is provided with one of these tin stoves which burns wood and brush

Two heifers curiously branded by Nature, one with a white N, the other with a white 7

Nature Herself Branded These Cattle

ONE of the accompanying illustrations shows a young heifer owned by Henry Nelson, of Hicksville, O., which bears the letter N on its side. This letter was not burned in, nor has it any resemblance to the scarred brand. The hairs are white against the reddish back of the animal. Just what caused them to grow in such a way as to form the owner's initial is a secret which Nature has kept. Mr. Nelson would like to know so that he could use the style of branding on his other cattle.

The other illustration shows a large white figure 7 on the face of the seventh daughter of a seventh daughter, which is believed to have special significance. Possibly the animal will yield seven quarts of milk at a time and will usher in a period when milk will be seven cents a quart. Or perhaps the 7 has to do with the year 1917. You solve it. We give up.

A Fowl and its Feathers Are Soon Parted—With This Machine

It was O. G. Rieske's wife who led him to invent a mechanical chicken picker. She chased him out of their Buffalo home one day for attempting to pick a wild fowl all over her nice, clean kitchen floor!

Now O. G. can pick his feathered properties in peace and security. For the machine he has invented leaves an ordinary fowl absolutely naked in less than five minutes. Moreover no feathers are scattered.

An electric motor furnishes the power by which the fowl is picked

A small electric motor turns a suction fan, and also a roller contained within the instrument itself, the power being transmitted by means of a flexible cable. The roller is hollow and its outer surface is pierced by a number of slits which permit the incoming blast produced by the fan to pass freely through it. The top of the instrument is hooded and attached to this hood is a little rubber roller which rests firmly against the surface of the larger drum-like wheel. The feathers of the fowl, sucked up against the two rollers, are plucked by having to squeeze between the rollers, after which they are blown to a tank. A thumb contact permits the hood to be moved around on its axis, and thus the relative positions of the two rollers are adjusted according to the needs of each case. The smallest wild fowl or the biggest turkey may be plucked with equal ease. A fowl can readily be picked in the dry state, but ordinarily it is scalded. This device is very useful in hotels and restaurants.

Riding a Moose in the Waters of Rainy Lake

On Rainy Lake, Ontario, the center of a virgin land where game abounds at all seasons, moose frequently swim across the arm of the lake.

After watching their chance and timing the chase when one of the animals was about the middle of the lake, some hunters cut it off by striking directly across from a point.

Paddling very fast in their canoe, they came alongside the animal and the man in the bow of the boat let himself from the canoe onto the animal's back. This in itself is a very difficult feat, as any one who has ever handled a tricky canoe can testify. Balancing himself on the animal's back, he suddenly let go and threw himself forward, maintaining his precarious position by grasping two of the points of the strong branching antlers. Thus he performed the very unusual exploit of making the lordly moose ignominiously carry his would-be slayer to shore.

This hunter performed the feat of ju[illegible] bow of the canoe on to the moose's [illegible]

How the Pueblo Indians Celebrate Their Thanksgiving

EACH year the Pueblo Indians who inhabit the two terraced, clay community houses which rise tier on tier to the height of five stories at Taos, New Mexico, celebrate the festival of San Geronimo Day. In the morning, races and dances are held; and in the afternoon, Indian clowns climb a thick pole, at the top of which hangs a dead sheep, vegetables and other food. The one fortunate enough to reach the top lowers the provisions to his companions, as the accompanying illustration shows. To climb this pole at all requires true Indian agility.

This Autumn festival is not so much a tribute to San Geronimo as a thanksgiving to the bountiful sun-god for the harvest that has been plentifully supplied. A great many tourists visit Taos and attend the picturesque ceremonies, which are held on the last day of September. There is not sufficient room to shelter them in the primitive little town, so they have to travel to the adjacent town of San Fernandez de Taos, two and a half miles distant. Here the canny Mexican population stages a celebration all its own, to extract from the travelers what loose coins they have.

Pueblo Indians climbing a pole to get the provisions which are attached to the top

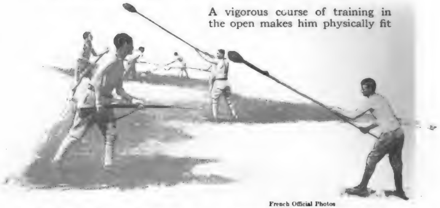
Non-Flying Air Service Needs Radio Men; Opportunities Wide in Range

RADIO amateurs, the Government wants you. It needs radio operators in the aviation service, not to fly but to receive messages airplanes send back to bases. Any railroad telegrapher, youths with elementary electrical knowledge, those already acquainted with wireless, and of course men with more advanced experience are all possible candidates. A training camp has been established at Camp Kelly, San Antonio, Texas. The course given, extends over a six- to eight-week period, and embraces primary power circuits, secondary power circuits, condensers, oscillations, radiated currents, ether, received waves, receiving circuits, detectors, wave meters, instruments, and in the final weeks requires students to take radio apparatus out in the field and communicate with airplanes under actual flying conditions. Radio repair men and mechanicians are also trained. College graduates with technical education are eligible for non-flying commissions. Additional information may be obtained by addressing the Chief Signal Officer, Washington, D. C. Applicants are enlisted as privates and remain as such until assigned their proper places in a squadron.

Maybe you have special needs. Write to the editor about anything within the scope of the magazine. He will be glad to help you.

Making the Frenchman a Fighter

A vigorous course of training in the open makes him physically fit



French Official Photos

French soldiers, stripped to the waist, learning bayonet charging by the Herbert method

ONE of the military problems France has solved is that of sending back her soldiers-on-leave to the trenches without their having lost any of their value as fighters. In fact, they go back better soldiers than they were before. When the poilus return from the trenches the sense of discipline is suddenly relaxed, to their military detriment. Often the men are highly nervous. The terrific noise of the battles they have been through, and the sleepless nights they have passed have weakened their stamina. Some are excited—intoxicated with success. Others are profoundly depressed. Soldiers recovered from shell shock are more unstrung than others.

All these men must be re-taught if they are to be sent back to the firing line. The time needed for re-education is ten weeks, during which period the soldier is schooled in the very latest methods of warfare.

Just what method shall be used in retraining soldiers is a moot subject. Lieutenant Herbert of the French Navy does not believe in the use of mechanical appliances such as are to be found in the average gymnasium. He thinks that natural methods are best. He takes his men right out into the open and puts them

Run a few yards on your hands and feet after the fashion of a monkey and you will be pretty tired. Yet these enthusiastic Frenchmen do not mind this method of locomotion at all

How the poilu is taught to handle the bayonet. Here he is advancing against an imaginary enemy. The dummy figures which can be seen in the background are bayonet targets

through a rigorous course of training.

Life in the trenches is far from easy. The men must be in fine condition if they are to stand the hardships. Herbert wants to bring out the best in every man. First of all he makes the men strip to the waist. This toughens their skins and enables them to stand severe weather. The training consists in climbing trees, running on their hands and feet, rolling on the ground, fording streams and practising military tactics. The men train every day no matter what the weather conditions may be. They are taught to throw grenades, charge trenches, use bayonets effectively and handle all the delicate machines and weapons which have been developed by this war.

As an example of what this training will do, take the case of an attack in a real battle which took place last April. A group of thirty-four grenadiers which was quickly reduced to twenty-six, threw eight thousand, five hundred hand grenades in three hours and a half. If these men had not been in the best physical condition such a feat would have been absolutely impossible.

French soldiers at one of the Herbert military schools. The men are developing their muscles by walking on their elbows and their toes. They always work stripped to the waist

A new sound-producing device. These hollowed cups cleverly imitate the clatter of a horse's hoofs

Ashes From Burned Wood Make a Good Fertilizer

DO not bewail the fact that the price of commercial fertilizers has gone beyond the reach of all except the wealthy farmer. It is because potassium oxide, one of the important ingredients of a good fertilizer, has jumped from four hundred to eight hundred dollars a ton. But any farmer can produce his own potassium oxide from the fresh ash of burned twigs, branches and other parts of such hardwood trees as the beech, birch and maple. It is a very simple process requiring a cheap apparatus and no complex chemical treatment. The College of Forestry at Syracuse will give information to anyone about the process.

How the Cavalcade Approaches Behind the Scenes

EVERY barnstorming company has as not the least important part of its equipment a pair of hollowed cocoanut shells, which in the hands of the stage mechanic, sound more like a horse than a horse itself. Now that most of our melodrama comes to us through the motion pictures, along comes an imitator of clattering hoofs to be attached to a stationary organ. It is operated from the keyboard by a lever or button. With the aid of a swell box, the sound can be made to swell or diminish.

The device consists of six cups, the upper three of which are secured to the bellows and the lower three of which are mounted on a solid base. To operate them, the organ player presses a key which causes the first cup to come down with a thud, followed in quick succession by the other two cups. There is no break in the action. The cups are made of maple. The inventor is Harold A. Valkenburg, of Oakland, California.

The toothed sides trim away enough wood to keep the blade from binding

New Key Hole Saw Which Will Not Jam or Bind

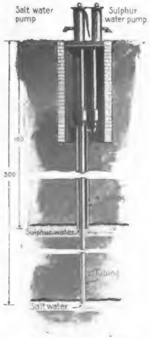
A NEW saw has been invented by A. R. Brewer, of Northport, Washington. It not only has teeth along one edge, as has an ordinary blade, but the sides and upper surface are toothed also. Made in this way, the saw can cut itself out of any predicament. The toothed sides automatically trim away enough wood to keep the blade from binding as it goes down into the cut. These same toothed sides may be used as a rasp to widen out laterally the hole that is being made.

The saw is designed for both rip and cross-cut work. The pointed end of the blade is channeled out much like a reamer, so that by giving it a twisting motion, it is quite able to bore its own way into the wood in starting a hole. The chisel-like handle provided at the other end, facilitates this action because the blade may be driven into the wood with a mallet if the twisting motion at the start does not prove sufficient.

A Well That Supplies Two Kinds of Water

"WHAT'LL you have, salt or sulphur?" This question is appropriate when one does "the honors" at a well at Welaka, Florida, for two kinds of water are "on tap" there.

The well first was drilled to a depth of one hundred and sixty feet. Here ordinary "sulphur" water was encountered. The drill was then carried to a depth of three hundred feet. Here a strong mineral water was struck. In order to use both kinds of water, a small tubing was passed through the upper casing of four-inch pipe and down nearly to the bottom of the well. Both this and the outer casing were connected with pumps. A favorite joke is to give visitors a drink of the weaker water in the first glass and then replace it with the brine in the second.



The double piping makes both the sulphur water and the salt water available

The United States Geological Survey has records of only about six wells of this kind in the country, but there is no reason why similar wells can not be obtained in regions where the waters in the upper strata differ from those lying deeper.

At Mulford, Utah, there is a "double" artesian well which has a flow of thirty-seven gallons per minute of pure water from a four hundred and fifty foot depth and another of two gallons per minute of strong sulphur water from a depth of seven hundred and fifty feet. A four-inch casing is used on the upper level, and a two-inch pipe extends to the very bottom of the well. These "double" wells have wide uses.

Home Portraiture for Snakes.—Try it on a Rattler

PHOTOGRAPHING snakes in their native retreats is a sport often overlooked by the camera enthusiast. It not only requires a high degree of courage on the part of the photographer to approach his quarry, but much time and patience must be expended before the snake assumes a position that can be readily caught by the camera. It goes without saying that photographing poisonous snakes, such as copperheads, water-moccasins and rattlesnakes, should not be undertaken by a novice, unless he be accompanied by a person familiar with the habits of such snakes.

However, it is just as much sport photographing harmless snakes. In the first place, you must know where to look for them, and secondly, having found them you must wait patiently until they get in interesting poses. Water-snakes make good subjects.


The snakes here photographed are harmless, but they are none the less interesting

The new Ford ambulance can not tip over backwards. Fold-down interior seats accommodate patients not badly wounded

New Ambulances Are Shorter Than the Stretchers They Carry

THE tendency of Ford ambulances to tip over backwards, because of the extreme rear overhang of the body, has been obviated in the new standard ambulance used for front-line trenches. The body measures half a foot less than the standard stretchers that it carries.

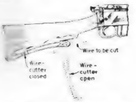
Four canvas-covered holes are provided in the back of the body, and into these holes the rear ends of the stretchers extend. Three of the holes are in the lower half of the tailgate, which folds down from a step. Two stretchers are carried on the body floor; their outside ends each extend into the holes on the outside, and the two adjacent ends into the center hole, which is twice the size of the side holes. The third stretcher is carried above the other two and in the center of the body. A similar, though larger, canvas pocket is provided to prevent the upper stretcher and its occupant from slipping out.

Wire Cutter Attached to Gun

WHEN the hail of shells upon the enemy's entanglements does not destroy them entirely, the soldier himself must complete the job. Hence it is that, along with a score of other instruments initiated in the present war, the wire cutter takes its place as part of the modern soldier's equipment.

While these new instruments are necessary, they are nevertheless a great encumbrance. A step in the direction of minimizing the unwieldiness of a number of separate instruments has been taken by Frederick A. Warner, of Halifax, Nova Scotia. The bulky pair of shears has been converted into a simple lever, attached to the soldier's gun in a groove underneath the stock. The hinged end of the lever, which lies towards the forward part of the stock, is pivoted between two short cutting blades. When a piece of wire is placed across the blades and the lever is swung inwards, the barbed wire is severed instantly.

The soldier backs the two short cutting blades against the wire and severs it



As long as the soldier is in action, he keeps his gun steadily pointed at the enemy. When he comes to an entanglement, all that he has to do is to back the blades against the barbed wire in order to sever it. Between cuts, the soldier keeps up his fire upon the resisting trenches, when in a position to aim with any degree of accuracy.

All Kinds of Commotion at This Theater; Electric Signs Cause It

MANY things would interest you if you happened to pass a certain moving picture theater out in a California city. For instance, a big cloth sign, mounted upon a framework, keeps moving back and forth on suspension wires above the doorway. Then too, the head of the actor depicted on this sign has an odd way of turning 'round and 'round in the most eye-arresting manner. Mere movement seems to be a good advertisement, for crowds of people are attracted by the sign.


The rectangular sign filling most of the picture is moved back and forth by an electric motor. The head revolves

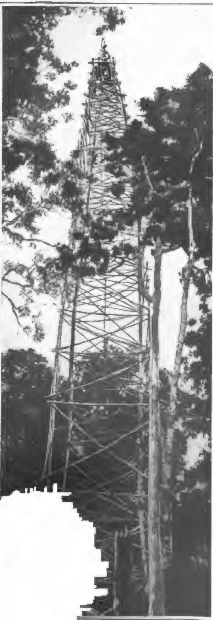
The revolving of the actor's head is simple enough. A small fan motor back of the sign does the work. Suitable pulleys and cord-belts reduce the speed. The sign, revolving head and all, is pulled back and forth by cords at each end, which run to a winding drum concealed at some point about the front entrance. The drum is operated by a second motor. When the sign reaches the right or left end of its travels, it trips a switch which reverses the driving motor and sends the sign in the opposite direction—this operation being continuous and automatic, of course, as long as the current is turned on. Motors may be reversed by reversing the field windings, by shifting the brushes or by rearranging phase connections. If you desire to experiment with electric signs, ask your local electrician about the motor.

The sign in position on exterior of theater. It is simple in construction

Shells That Burn and Suffocate

THE so-called "tear shell" used in the war in Europe is a hybrid between poisonous gas and the high explosive shell It is an ordinary shell of high bursting qualities which is filled with a charge of intensely irritating chemicals. These, as they shower from the shell upon the men in the trenches, affect the eyes and cause great discomfort. The men who are attacked unprepared, become overpowered almost instantly, for none can stand the intense irritation for more than a second. The tear-ducts open to wash the eyes, but their action has little effect upon the strong chemicals.

The nature of the active substances used has been the cause of much speculation. It is believed that very common substances are employed, for such unmysterious edibles as onions and peppers, can produce intensely irritating effects on the eyes. Red pepper abounds in Hungary, so it is likely that some of it is used because of its cheapness. This pepper is not only irritating, but it is known to give off an extremely pungent odor which renders the air difficult to breathe. Fortunately, preventive measures can be adopted. The hoods that have been used over the head during poisonous gas attacks are just as effective here in mitigating the action of irritants.



of these towers so that the
...st and Geodetic Survey
...nd of dense jungles

Building Eiffel Towers in the Philippine Jungle

THE accompanying photograph illustrates one of the many hazardous tasks which the engineers of the Coast and Geodetic Survey must undertake in order to overcome the obstacles of nature. Six towers, similar to the one illustrated, and ranging in height from 190 to 230 feet, were built to enable the surveyors to get long sights in the flat jungle country of southern Palawan, an island of the Philippines.

The feat is all the more remarkable when one considers the fact that the work was done by half wild Filipinos, many of whom were unable to understand English. Under the supervision of two American officers, the towers were built entirely of rough trees and saplings cut in the forest and carried to the station on the shoulders of the natives. Wire and nails brought from the Coast Survey vessel were used to fasten and secure the structures.

Some of the towers were located back several miles from the coast, so that the party had to camp on the spot. It was necessary to "pack" all of their outfit and provisions, even to drinking water, through the dense jungles and swamps where it was impossible to travel unless two or three natives went ahead with their bolos and cut trails. The natives were found to be excellent at tower building; they could climb up and around with almost as much agility as monkeys. In spite of the dangers naturally incurred in working on such crude structures and at so great a height, enough natives always volunteered to "work topside." The risks they ran would make those of our better known steeplejacks and steel workers look tame by comparison.

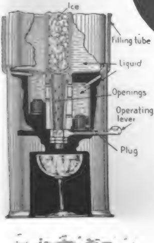
The towers are composed of two separate structures, one inside the other. This is necessary in order that the theodolite (the instrument used to measure the angles to far distant stations) may be free from vibration. Mounted on top of the inner tower, it permits the observer to walk on the outer one without shaking the instrument and disturbing its adjustment.

The Brainless Drink-Mixer. It Never Makes a Mistake

It is said that an efficient drink-mixer is a rarity because it is practically impossible for a man to make two drinks, composed of the same ingredients, taste alike. But with the drink mixer invented by Nicholas Jacovatos, of New York city, the mixing is done automatically and carelessness is eliminated.

His drink mixer resembles an ordinary ice-water cooler. In the interior are a number of compartments holding different flavors or liquids. The compartments are filled through tubes which extend to the outside, avoiding the inconvenience of lifting the cover to replenish the supply. One side of each compartment rests against a chamber containing ice, which keeps the contents at a constant temperature.

To obtain a mixed drink, the operator turns a lever, which causes a valve connected with it to mesh first with one compartment and then with another, until the several liquids which make up the desired concoction have all been released into the glass.



Above: To make your mixed drink you simply turn the little lever

At left: The interior compartments and mechanism of the mixer

Raising water by the oldest of treadmill methods is still common in China. Hundreds of such mills are in use

A Twentieth Century Treadmill in China. It is Run by Man-Power

While all the western world is echoing the slogan "Do It Electrically," and pulling down old machinery in order to install new devices requiring fewer operators, China is still employing the man-power tread-mills shown in the accompanying illustration. Here men, women and children take turns keeping the mill going and thus pumping water into the reservoir seen at the left of the picture.

The four treads of the mill are supported on a crude framework.

A Floating Match-Safe Made from a Shaving-Stick Container

Certain brands of shaving sticks come in strong metal containers which may be converted into useful match-safes for the camping outfit. These boxes hold fifty matches, which are enough for the use of one man for two weeks.

Although the cover fits well, the match-safe will not be waterproof unless a strip of adhesive plaster is wound around where the cover joins the box.

Fake Messages from the Spirit World

How mediums read "messages" sent them to be answered

By Hereward Carrington

SCENE:—The rooms of a professional spiritualist. The medium asks a number of persons to write out questions on a piece of paper and to fold up the papers. After the papers are gathered up, they are placed on the small table or "altar" in front of the medium. The eyes of the medium are bandaged. She cannot see anything—apparently. The investigators take their seats, and the "readings" begin.

One by one, the medium picks up the papers, places them to her forehead and proceeds to tell what question each contains. Miraculously enough they are the very questions asked by the writers. But the medium does more than read the writing on a folded paper. She proceeds to give advice, or more often mere impressions, which are taken as partial or complete answers to the questions by emotional and imaginative listeners. With the answers, then, we need not concern ourselves. They consist only of vague advice and guesses.

How, then, does the medium find out what is written on the carefully folded papers?

There are various ways. The illustrations disclose some of them.

Under cover of a pile of folded papers, or perhaps of some small ornament on the "altar" the medium quietly unfolds the pellets, one at a time, and reads them under the bandage. Folding them up again, she places them to her forehead and pretends that she is only then making out their contents with the greatest difficulty. The spectators are impressed!

But suppose the medium's head is covered up by a thick sack. Surely she can't see. What then?

In this case, the trick is rendered possible by the very means which seem to make it impossible—as so often happens! Under cover of the sack, the medium has taken from under her skirt an electric flash lamp, and by its aid she reads the contents of a number of questions she has concealed. In this case, a number of dummy (blank) pellets are left upon the table, to take the places of those sur-

How can she read with a sack over her head? It's easy —with a flashlight. At right, a medium's pad with its revealing carbon paper

reptitiously abstracted, so that the number remains approximately the same. This is done either by the medium herself or by the assistant, who collects the pellets and superintends the blindfolding of the medium.

Often the original slips *are* left on the table, and *no* dummies are substituted. If this is done, all of the questions must be written on previously-prepared pads containing a carbon-sheet so that an imprint of the question is obtained. Sometimes the under side of one of the sheets of paper is prepared by soaping it thinly. This is pressed upon the lower sheet; and the medium has only to rub the lower sheet with lamp-black or charcoal to obtain an imprint of the message.

If the "message" is placed in an envelope, and this is sealed, the medium can often see what is written on the pad simply by rubbing over the envelope with a small sponge dipped in alcohol. The envelope will at once become transparent, Nothing will do but alcohol, which dries out almost at once, without wrinkling the envelope, which can be stood upright, on the table, for a few moments, while drying,

Deep mystery, but not to those who know the little ways of fake mediums

To obtain an imprint of the message rub the paper with lamp-black or charcoal

Reducing the Egg Loss Due to Breakage in Shipment

As spring approaches, the cackle of the corn-belt hen is the preliminary announcement of the shipping of millions of white and brown eggs to the large cities of the East. The eggs leave their shipping points packed in cases supposed to insure their safe delivery, but the fact remains, as established by Government investigations, that two dozen eggs out of every thirty dozen cased, reach their destination in a cracked, mashed, dented or leaky condition.

For New York city alone, this means that one hundred million eggs are annually found to be in a damaged condition following their arrival from the shippers. This causes an annual loss of three million dollars to poultry dealers.

An inspection of crates shows that they have been carelessly nailed up. On the other hand, the Government inspectors find that nineteen eggs in each case are cracked before being loaded on the car, and that careless packing in old and flimsy cases accounts for the additional breaking of five more eggs in a case.

To eliminate this tremendous loss, shippers are resorting to all sorts of packing methods. Some have found the old-fashioned splint basket, when packed with excelsior as a shock absorber, to cause the least damage. For one hundred eggs or larger shipments, a barrel with the eggs packed securely in excelsior, has met with partial success. The ordinary egg crate has been discarded where shipments are made over a considerable distance. Some shippers are packing each egg so that it is the center of a ball of excelsior. This is an expensive as well as a laborious method but it does insure full protection for the exceedingly fragile egg.

What's the Matter With You?

The illuminated skeleton tells. The organs are indicated by incandescent lamps

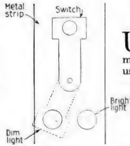
DR. RATLEDGE, of Los Angeles, has a novel and rather startling method of explaining to you what he thinks is the matter with you. He hangs a skeleton in a frame of piping and indicates the positions of the vital organs by means of incandescent lamps. Small lights are placed in the eye sockets, and long lights are placed along the arms and legs.

Current is turned on or off to indicate a healthy or diseased condition

Along the spine, where the many nerves branch off to the various organs, are placed electric switches which control the various lights. To illustrate what happens to the vital organs when the nerves leading from the spine become pinched or otherwise injured, he turns the switch so that a very small amount of current is supplied to the particular light that represents the organ which is supposed to be diseased or misplaced. This lessening of current causes the light to burn very dimly. This is supposed to illustrate the manner in which the force flowing to the vital organ is shut off when the nerve leading to that organ is in any way obstructed. To illustrate what happens when this obstruction is removed by the manipulations of the spine, the switch is turned over a notch to supply more electric current and cause the lamp to glow brightly again. To explain what happens when a nerve is so pinched that no nerve force can pass, the switch is turned so that all current is cut off which extinguishes the lamp. The switch works somewhat like the familiar high-and-low light that burns brightly in one position of the switch and low in another.

There are five switches, each working independently of the other. For instance the light representing the heart may be burning brightly, but the one representing the stomach may be exceedingly dim, thus illustrating the fact that the current leading to one vital organ may be exceedingly strong while the current leading to another may be very weak.

We are not in accord with the doctor's medical theories, but we think his apparatus is one that can be employed to advantage in driving home knowledge to people who cannot understand the jargon in which doctors usually manage to conceal what they think they mean.



Switch on spine swinging to contacts varies brightness

Licking Stamps Is Very Unsanitary

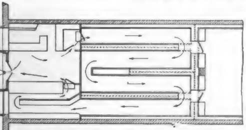
USE a dampened sponge to seal your letters and to moisten the stamps. The glue used on stamps and evelope flaps is made of bones and hoofs of cattle, and all sorts of rags are used in paper. Besides, although they may have been sterilized, the articles pass through many dirty hands while on their road to you.

You Run This Store Yourself

But there is a cashier at the door

IN these days of conservation, it is very appropriate that a new grocery store—a wasteless grocery store—has made its appearance. It is the invention of Clarence Saunders of Memphis, Tenn. The grocery which Mr. Saunders has patented, lowers the cost of operation for its owner and lowers the cost of food for the consumer.

Saunders' grocery runs itself. There are no clerks. When you go into the store you enter a turnstile, pick up a basket and are free to do your shopping without any interference. No polite clerk persuades you to purchase something you don't want. Every article is labeled plainly and displayed on the counters in such a manner that you simply help yourself. You make your selections in your own way.



A plan showing how customers enter and leave the first grocery store which ever was patented

The aisles are so arranged that you progress through the store in a given direction. When you come out, you find yourself opposite a checking and settlement counter. A clerk checks off your purchases and you pay him for what you have taken. If you have made no purchases, you simply pass out.

Naturally the overhead expenses are much less in a store of this character than they would be if a staff of clerks was kept in attendance. The waste is much less than it is in the average grocery store. In weighing food hurriedly there is often a loss of a little of the substance being weighed, as well as the danger of the weight being over or under the desired amount. When the material is weighed without hurry or anxiety, the results are more satisfactory.

The customers select their own groceries and carry them to the checking counter where they are paid for. The customers then wrap up their packages and carry them home

Soothing Our Soldiers Electrically

Electric cages will put new energy in them when worn out. Trench-foot and shell shock also to be aided electrically

By Lloyd E. Darling

Of course, you wonder what the picture on our cover means. You see a medical officer operating electrical apparatus, and also a marine inside of a cage. What's the marine in for?

So we introduce to you a little known development in the field of science.

Government officials recently decided to establish in all American war hospitals in this country and Europe, electrical apparatus for the treatment of wounded and ailing army and navy men. And the peculiar part about it is that the apparatus to be used is not unlike that which every young experimenter in this country has played with for a long time past. The coils and condensers of the boy's wireless apparatus are familiar objects; also the glass-plate static machine that he inherited from some lightning rod demonstrator, or that he made himself. That such machines as these, though naturally of larger size and better quality, have a practical usefulness in an army hospital is unexpected.

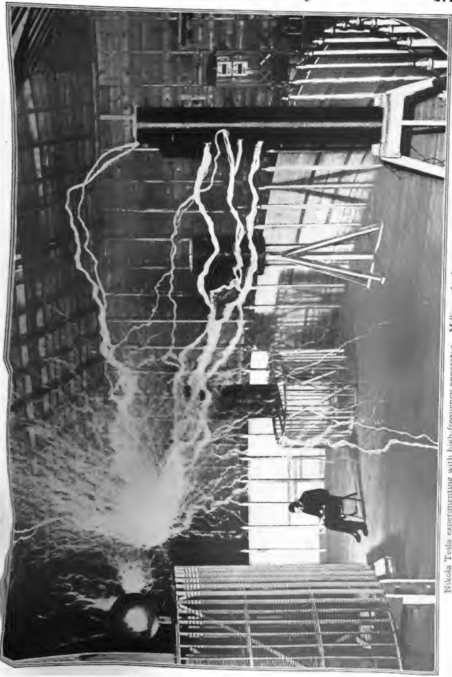
Electrical currents of some types are of special benefit in the many ills common to soldiers, and in particular to those that do not yield readily to ordinary treatment. For instance, trench foot. What is trench foot? It is a disease likely to afflict any of our men who have to stand for hours at a time in cold, water-filled trenches and in the slime and ooze that covers battle grounds. At first, a man loses all feeling in his feet. They swell and pain. Gangrene may develop. Then there's rheumatism, sciatica, lumbago, the "trench back," which frequently results when men have been buried alive, frost bite, shell shock, neuritis, wounds from which there is a large discharge of pus; sprains, contusions, skin diseases, hysterical paralysis, tissues broken up by irregular bullet wounds, and so on. Don't get the idea from this array that electricity is a cure-all and the long-looked-for panacea. It is only lately that the curative properties of electricity have been systematically utilized. It takes a head to be both a doctor and an electrical expert. This is the principal reason why the system has not been applied before. But as far back as 1907, in the Moroccoan war, the French found electrical methods invaluable. In this war, they have been developed to a still greater extent.

Most men have heard *a little* how electricity may be used to benefit and cure certain ills. They know that doctors—some of them quacks—sometimes use electrical apparatus and that there is always a great to-do around such places, what with the sparks and everything. But just what does it amount to?

Says Dr. William Benham Snow, an authority on the subject:

> Electricity operates in three principal ways in the curing of disease; mechanically, chemically and thermally. These are the same actions as electricity brings about among machines. In other words, the mechanical result produced is an actual movement of or in the flesh, due to the direct stimulation of the muscular cell, or as a result of the nerve and muscular mechanism acting together. Contraction results. Chemical effects may be of the electrolysis order, or in the nature of cooking, or may be actual chemical reactions within the cells as a result of the electrical stimulus. Thermal effects may border on those of chemical nature, but especially result in increased blood circulation through an affected part, stimulating greatly growth of bacteria-destroying blood cells, and so on. The especial advantage of the heat produced as a result of electrical apparatus is that it may be made to permeate an affected part in just the right way. The field for electrotherapy has widened immensely since the war began.

The man on our cover is *surrounded* by electricity. He sits in an invisible electrical field, produced by what is known as a d'Arsonval apparatus, much like a Tesla coil, except that the current is greater. The man in the cage is permeated through and through by the electrical field. You know if you take an ordinary electric light current and send it through a small coil of wire in which is an iron core, you can heat the core red hot if the current strength is great enough. Eddy currents are set up in the core.



Nikola Tesla experimenting with high-frequency apparatus. Millions of volts come from coil at left. His invention of the Tesla coil made possible one whole branch of electrotherapy. Here he is transmitting power wirelessly

iron molecules are slow moving and cannot adjust themselves rapidly enough to keep up with the fast alternations of the current. As a result, they jostle one another, and heat is developed.

The man inside this d'Arsonval coil is somewhat like the iron core of the familiar coil. Every cell in his body is being stimulated just as were the molecules of the iron core. He feels no pain, because high frequency currents have the peculiar property of going through a man without his feeling it, yet stimulating the functional activity of all his cells and organs immensely.

D'Arsonval coils are of particular value in treating hardened arteries and similar afflictions. But this is not the only apparatus the electrotherapists now use. X-Ray machines, electric lights, static machines, Tesla coils, vacuum tube electrodes and specialized variations of these are all a part of the regular equipment.

The young man of electrical or mechanical bent will find electrotherapy an interesting field. It is as attractive as radiotelegraphy. But the subject should be given sound study. The shallow knowledge of quack doctors brings trouble. Know both the medical and the electrical ends well.

For Recreation Only—Detroit's Innovation in Buildings

WHAT is said to be the largest establishment in the world set apart for recreation alone, has recently been erected in Detroit, Michigan. The second and third floors are equipped with one hundred and five billiard tables. The fourth floor is for ladies and has twenty-two regulation tournament bowling alleys. All the employees on this floor are women, including twenty-two women pin setters. The fifth, sixth and seventh floors have twenty-two regulation bowling alleys each and offer unusual accommodations for league and individual matches. There is also a restaurant, a cigar store, soda fountains, a barber shop and a reading room. For exhibition games and lectures, a billiard amphitheater is provided.

The largest building in the world set apart for recreational purposes alone

An innovation has been made in the lighting system, which throws a diffused light over the floors devoted to bowling, the brightest light being shed directly on the white maple pins. This is a great aid in aiming the shot. The alleys are numbered so that the players have no difficulty in locating the proper alley from any point on the floor.

There are twenty-two women pin-setters in the ladies' bowling alley which is fitted with every convenience

Mount a snow plow in front of a locomotive and simply melt away all the snow drifts you encounter. An inventor has provided the extra apparatus that is necessary

Just Melt a Snow Bank Away. But It's Not a Simple Process

JUST now when railway men all over the country are struggling with overpowering snow storms, we know they will be interested in a Middle-Westerner's invention whereby all their troubles may literally be melted away. His idea is to mount a snow plow in front of the locomotive—a snow plow provided with innumerable steam jets by which all snow encountered may be rapidly reduced to water. It is easy to do this, merely a matter of having coal enough in the tender.

The inventer provides pipes by which the water accumulated, may be delivered at will, to the tender, or distributed freely along the right of way to freeze and hold down drifts. Perhaps the blowing action of the steam jets may assist a plow in loosening up its obstacles. But when the disposal of snow by melting action alone, and with steam as the source of heat, is considered, the question of practicability arises.

It takes eighty calories of heat to reduce one gram—a small teaspoonful—of ice at 32° F. to water at identically the same temperature (32° F.), or as much heat as it afterwards takes to raise the teaspoonful of (now) water from 32° F. to about 175° F. In other words, ice takes an immense amount of heat just to melt it. Of course, snow isn't *literally* ice, but as an almost limitless absorber of heat it is a close rival.

Good strong rotary plows are proving very useful as disposers of snow.

Your Automobile Can Be Made Into an Ambulance

ANY five-passenger car can be made into an ambulance that will carry two men, by attaching a gas-pipe framework, invented by Captain Gans, of Philadelphia, Pa., an officer in the Medical Corps.

The stretchers are slung from the racks. The light variety weigh not more than fifty pounds.

A pleasure automobile made into an ambulance. Two wounded men can easily be carried on the stretchers

Beating the Coal Dealer with Paper "Coal."

HOW to save one-half the coal bill and utilize the accumulations of waste around the house is suggested in the use of a simple press which converts waste paper, newspaper, letters, torn wrapping paper, old cardboard, old cord, rope or anything else that is combustible, into compressed bricks for burning in the stove or range. When used in combination with coal, the paper bricks make a very hot fire.

Rags and all burnable waste are first dropped into a pail of water. When they are thoroughly soaked, they are taken out of the water and stuffed into the cylinder of the press. The wheel is then turned, forcing a piston against the wet waste, and crushing the mass into a compact form. The brick is then removed from the press and set in the sun to dry, after which it is ready to be used.

The dry paper bricks may be boiled in paraffin and used as candles in the trenches. Strips of newspaper rolled up tightly into cylindrical form and then boiled in paraffin have already given much satisfaction as trench candles. Since the bricks are larger and more compactly pressed, they will burn much longer than the paper-strip candles.

When pressed into bricks newspapers and other waste will burn like coal

The High Pressure System Applied to the New York Fire Department

IN the accompanying photograph may be seen four streams of water being played on an imaginary fire in New York city. The stream nearest the ground is from a low pressure hydrant, the maximum pressure being only eighty pounds. The stream next above it is from a fire engine. In this case the pressure may be as high as from three hundred to four hundred and fifty pounds, which is sufficient to discharge from seven to nine hundred gallons of water a minute.

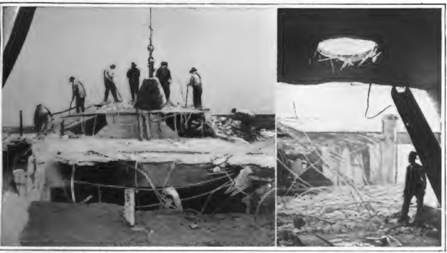
Two high pressure streams are shown, one delivered from a deck pipe and the other from a water tower. The deck pipe stream, operating at a pressure of one hundred and seventy-five pounds, delivers one thousand, five hundred and ninety gallons of water a minute. The water tower, operating at one hundred and fifty pounds, delivers one thousand, four hundred and seventeen gallons of water a minute.

A water tower delivers water to the fifteenth floor, a deck pipe to the eighth floor, and a gasoline pumping engine has delivered working pressure at the fifty-sixth floor of the Woolworth Building. There are twenty-three hundred high pressure hydrants in New York city.

The four mighty streams of water with which New York fights fires

Pounding a Building to Pieces

How a huge iron ball was used
to demolish a concrete structure



The iron ball, weighing over half a ton, is suspended on a single fall line. This implement, together with a stiff-leg derrick and a boom is mounted on a convenient movable platform. At right is shown a good sample of the device's handiwork

POUNDING a reinforced concrete building to pieces with a one-thousand-two-hundred-pound iron ball was the novel method used by a Chicago wrecking company. The building in question was an eight-story structure. It was designed to carry heavy printing machinery, and was unusually strong.

In order to save labor, the wrecking concern conceived the idea of using a cast iron ball, weighing over half a ton. The wrecking outfit, carrying the ball or "skull crusher" on a single fall line, consisted of a stiff-leg derrick and forty foot boom, mounted on a sixteen by twenty-four foot platform on rollers which were built for this particular job to facilitate the steering of the platform between the columns of the building.

In wrecking a floor the ball was dropped from a height of about forty feet on the central parts of a slab, until the concrete was shattered up to the column capitals or to the edge of the beams, after which the reinforcing bars were cut by means of an oxy-acetylene flame.

The blows of the ball were then directed over the center of the column, where they broke the concrete away from the rods at the base of the columns at the next lower floor for a height of approximately four feet. When as much as possible of the column concrete had been broken off by this method, a wood fire was maintained around the column base for eight hours. Then water was thrown on the column. This had the effect of cracking the concrete and weakening the column so that when the column reinforcement had been cut with the acetylene torch, a block and tackle attached to the electric hoist easily pulled the standing mass over. Portions of the brick walls not backed by concrete were knocked over by swinging the ball against them. After breaking all but one panel of a floor, the wrecking machine, moving under its own power, on an inclined runway, was lowered to the next floor.

Fifty Thousand Operations to Make a Car

How they are performed on the minute by means of the wonderful "Control Board"

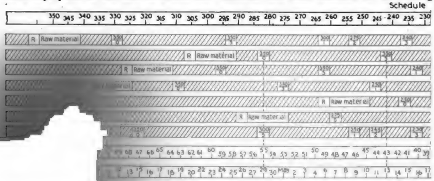
By Reginald Trautschold, M. E.

THE automobile is now so familiar to us that we have ceased to realize how complex a machine it really is. Fifty thousand or more manufacturing operations are required on a car, and each operation must be performed at exactly the right time.

As a guide for the issuance of orders, and as a standing record of progress made in the shops, Major George D. Babcock, production manager of a great automobile company, has devised the "control board." Vertical boards are covered with a curtain of horizontal metal strips, some ten feet long and about six feet in depth. These curtains can be raised or lowered, and strips can be inserted or removed. Each strip is devoted to the graphic depiction of the progress made on some particular one of the numerous parts manufactured. There are about one hundred such strips on each control board.

The horizontal distances along the strips represent work days, so that a vertical line at the extreme right of the control boards may be taken as representing the date at which the car must be completed. A distance to the left of such a completion or zero line on any strip will then measure a definite number of work days prior to the date at which the car should be ready to leave the factory. At the proper locations on each strip are small square blocks, known as "cages," each representing a specific operation in the manufacture of a particular part. The distance of each cage from the zero line indicates the date at which work on each operation should be commenced. For instance, take the strip devoted to Part *B*, in the illustration below. This part is required thirty days before the automobile is completed, but no earlier, and, of course, no later. A cage is therefore mounted on the Part *B* strip, thirty work days to the left of the zero line, to indicate that thirty days before the car's completion Part *B* must be finished.

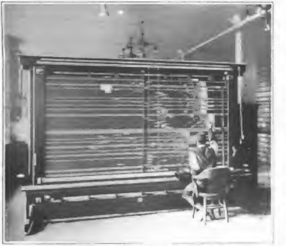
Two mechanical operations are required to complete Part *B*, each one of which requires a work day. A cage indicating the second operation is then mounted on the Part *B* strip to the left of the "finish" cage, separated from the latter by a space representing one working day, and another cage for the first operation is mounted the same distance to the left of the cage for the second operation. The distance between cages represents the time required for the operation immediately to the left; the space occupied by the cages themselves denotes the time allotted to examining



a close view of the control board. Schedule tape at top is moved one ...ted to date. Part A, and the other strips, show progress on the parts of

the work, and to moving it to the machine employed for the next operation.

Prior to the first operation on any part, the necessary material must, of course, be in stock, or in "stores." To guard against any possibility of failure, it is well to have the material in "stores" a few days before it will be needed, say eight days, so another cage is mounted on the strip, eight days to the left of the first operation cage. To the left of this "store" cage is an "order" cage. This "order" cage is mounted such number of days to the left of the "store" cage as may be needed for the filling of the purchasing agent's order. A few work days to the left of this "order" cage is placed a requisition block, specifying the kind of material needed, to act as a guide for the purchasing agent so that he may make any necessary search of the market, or bargain for fair prices.

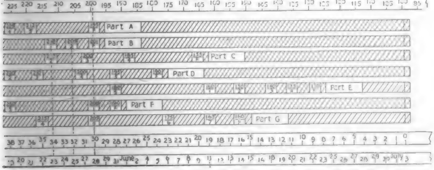


Operator seated before a "Control Board" figuring from reports the numbers he should post for the day

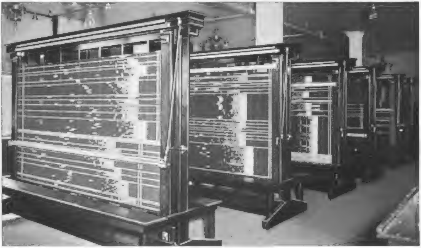
This completes the record of the required progress for Part *B*.

The requisite progress on every other part, whether a unit part or composed of several unit parts, is similarly mounted on its individual strip. This mounting of the control boards is permanent just as long as the same model of automobile is built and each strip contains full directions for all operations and acts required in the manufacture of its particular part.

Mounted so as conveniently to measure the location of the cages are two "work-day" tapes. The upper tape is divided into consecutive work-day periods and is used to measure the distance of the various cages from the zero line. The lower tape is similarly divided, but marked so as to read in calendar work-days, i. e., the days of the month, omitting Sundays and holidays. A third tape, a



division to right each day. According to the "100" at its right end, one hundred cars a car. At the bottom of the control board are metal tapes showing calendar days



"Control Boards" in actual operation in a large automobile factory. Progress on thousands of different parts is closely followed, material is provided, and the work is checked

"schedule tape," mounted at the top of the control board is provided, which in total length equals the number of work-days required to complete one car. It is divided into increments, or small divisions, representing the number of cars to be completed by the date indicated on the tape. This tape is moved one work-day division to the right, each day, so that its reading directly over the zero mark of the control boards specifies the sum total of the cars which should be completed on the particular day.

In the diagram, the schedule tape reads 100 at the zero line, indicating that one hundred of the three hundred and fifty cars in the lot should be completed on the day in which the schedule tape arrives at the position shown.

The numbers in the upper section of each operation cage indicate the progress of work on the numerous parts and are changed as reports of progress are received from the factory. For the various operations to be exactly according to schedule, the number posted in the cages should agree with the numbers on the schedule tape immediately above the individual cages. When the numbers posted in the cages are larger than the numbers on the schedule tape immediately above, it means that the pro[illegible] the part denoted by the particular cage is ahead of schedule, while when the posted number is the smaller, progress is behind schedule and the difficulty can be investigated at once before there is a serious delay.

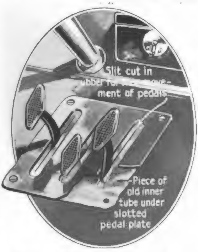
The control board not only definitely indicates the date and size of every shop order which has to be issued, but also shows exactly what progress has been made day by day on every part entering into the mechanical construction of the automobile.

The shop management has thus a continual record and can push or retard work on any part or on any operation so as to efficiently and economically maintain schedule. In a lot of but three hundred and fifty cars, this means a reliable guide and record for as many as ten million separate operations.

The control board presuppos[illegible] facturing under the most a[illegible] tific methods. Photo[illegible] taken frequently [illegible] the progre[illegible] the [illegible]

Stopping That Draft from Ford Pedal Slots

ON a Ford automobile, it is unpleasant in the summer to have the hot air from the engine blown up through the slots cut for the pedals and the handbrake, while in the winter, cold air coming up is uncomfortable. To remedy this little defect, remove the iron plate around the outside of the slot and place pieces of live rubber taken from a worthless inner tire, between the plate and the footboard, after which the plate is again screwed down tightly. Slots are then cut in the rubber.



Pieces of live rubber are placed between the plate and the footboard

The Champion Single-Handed Noise Producer of the World

WHEN some Philadelphia hostess invites Mr. Henry Eckert Reeves to come and entertain her guests, Mr. Reeves does not appear with only a modest roll of music. Not he! He brings with him a bass drum, a snare drum, a tambourine, a rattle, a tom-tom, a cow-bell, a steam-boat siren, a xylophone, sleigh bells, cymbals, bird calls, and various nameless but vociferous instruments such as one which imitates the roar of a cataract, or of breaking waves.

Then, using a talking machine to add the notes of the piano and of the violin to the musical mélange, Mr. Reeves gives his extraordinary one-man concert, during which he establishes a record for musical ambidexterity. Fire, flood and catastrophe are mild noise-producers compared with the agile Mr. Reeves.

This musician manipulates the most remarkable collection of instruments ever assembled for a one-man concert

Ears Rust Out More Quickly than They Wear Out

OUR recruiting officers have made an interesting discovery in gaging the relative fitness of city and country boys for service in the Army or Navy. City boys have better ears.

From the Washington records of the Marine Corps come the assertion that only one boy in five among those recruited in quiet neighborhoods has the acuteness of hearing possessed by the average dweller in a noisy town. The rejections on the ground of defective hearing were in the ratio of five to one in favor of "city ears."

The surgeons and scientists assume that the quiet of country districts tends to weaken, through disuse, the nerves in the ear, while the constant clamor of the city, really keeps the aural nerves responsive.

The Hell-Trench of the Piave

How an attacking German force was electrocuted as it rushed a second line of trenches

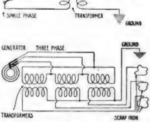
By E. T. Bronsdon

How eight thousand Germans were electrocuted near the Piave River. They rushed a trench filled with scrap-iron charged to high voltage by power plants from two adjacent towns

WHEN the Italians stopped, a few weeks ago, with their backs to the Piave River, in northern Italy, with the intent of delaying the Austro-German advance as much as possible, an incident occurred which illustrates the scientific resourcefulness of the Italians and also shows how much of a factor the unexpected can become, even in this warfare of to-day.

It was certain that no long stand could be made on that side of the river; the Teuton preponderance in men and guns was too great. Any expedient which might gain hours, however, was worth considering.

An Italian engineer by the name of Mertilli was responsible for the plan. Before the final German thrust was delivered, Mertilli caused the second-line trench to be evacuated over a front of eight miles, except by workmen.



Connections the Italians may have used. Instead of the single-phase and three-phase circuits above shown, direct current may have been available

In this second trench he placed some discarded machine guns, plates of corrugated dugout armor, and even some veteran field pieces, which seldom made an appearance in the trenches. The whole floor of the trench was lined irregularly with pieces of metal of different kinds, so that no matter where a man might step he was likely to touch one of the pieces. Then service electric cables were stretched to the trench, across the Piave, from two of the small towns just on the other side. These carried the heaviest charge of

electricity the plants were capable of turning out. The cables were connected up by concealed wires with all the bits of metal, the machine guns, the field pieces and the corrugated armor. Safety zones were left for the escape of the defenders of the first trench, but all other parts were connected with the electric cables.

The next morning the German mass attack came, driving the first trench defenders back remorselessly. The huge body of men swept over the first trench, and on to the second.

Something radically wrong appeared there. Men jumped into the trench, and it appeared to be evacuated, yet the invaders did not re-appear. The charging Germans behind could not know what was wrong. They came on and on, seizing the machine guns, the old field pieces and whatever they could lay hands on. It is needless to say that none of these lived to tell the tale of their captured trophies, for each was electrocuted where he first entered the trench.

The electrical slaughter was silent and terrible. The German regiments coming up behind could not know what was wrong

All along the eight miles, the condition was the same. Of course the German command soon found out what was wrong, but not until nearly eight thousand of the very best of Germany's troops were dead—and all without a single Italian casualty! And besides, the attack was halted for a day giving the Italians time to reorganize their defenses, on the other side of the Piave.

The Seal Which Is Used on Our Paper Money

A RELIC of the Revolutionary days when we were not yet a nation still remains on our paper money. The seal which appears on every bill issued by the Government contains the abbreviated words "Thesaur. Amer. Septent. Sigil. The full phrase is "Thesauri Americana Septentriomalis Sigillum," which simply means, "Seal of the Treasury of North America." Our distinguished ancestors felt that if a thing were to be said with dignity, it had to be said in Latin.

Don't Light a Match. Read Your Clock in the Dark

SMALL, flat disks treated with a radium compound are now being glued on the dials of clocks at the five-minute points and also to the hands so that the clock can be read in the dark. A complete set of eleven disks and a pair of hands can be affixed to a clock in a few minutes.

Disks treated with a radium compound are placed at the five-minute points and on the hands

The glow is practically everlasting and the disks, according to the manufacturer, will outlast the mechanism of the clock itself. The disk is omitted from the 6 of the clock so that the dial may be read instantly.

For automobilists, campers, hunters, doctors, nurses and soldiers this clock is a great convenience.

Loading Bullets Without a Mistake in the Weight of Powder and Shot

A RIFLE-SHELL must contain just so much powder, or else the range and accuracy of the weapon will be seriously affected. The shell casings, the bullets and the little primer caps that set off the shells are made up in large quantities and are as similar as human skill can make them.

The primer cap is inserted in the base of the shell before loading. Hence it is only necessary to load the shell casing with the necessary weight of powder, insert the bullet and clinch it firmly into position to secure uniformity in completed shells. Without mechanical aid this would mean extremely careful weighing of the powder, transferring the powder to the shell, tamping it firmly in place, inserting the bullet and, finally, clinching the end of the shell-casing about the bullet, this last operation requiring mechanical assistance. Altogether it would be a tedious task, this loading of shells by hand, and one in which there would be great likelihood of error.

With this semi-automatic machine, the whole operation of loading a bullet occupies but a few seconds

To avoid such a great waste of time, the machine, here shown mounted on the well-lighted [illegible]kbench, has been evolved. [illegible] composed of adjacent [illegible]al chambers mounted [illegible]ommon funnel, in one [illegible] is placed the powder [illegible]d in the other the bul- [illegible]car (the loader) has but [illegible]ulate the lever in his [illegible]nd, first to feed just the [illegible]mount of powder into [illegible] placed under the load- [illegible]ection just below the top of the bench, and then to feed in the bullet. By means of a foot treadle, the bullet is pressed firmly down on the powder; the casing about the bullet is clinched; and the clamping device is lowered and released so that the loaded shell may be removed by Oscar's left hand.

The whole operation of loading with this semi-automatic loading machine occupies but a few seconds and the work is done correctly, without possibility of error.

A Very Busy Sun Dial

"Let others tell of storm
and showers
I'll only count your
sunny hours."

THE mammoth sun dial which has been erected in San Francisco, by a realty company, must have a busy life because in the bright California climate, sunshine and daylight are almost synonymous terms.

In spite of all the modern timepieces available, the symbolic sun dial is enjoying an unexpected renaissance.

This huge sun dial is thirty-four feet in diameter

Motoring on One Wheel

It's kept upright by means of a gyroscope and is steered by a gyroscope also

You can swing around corners easily on this machine

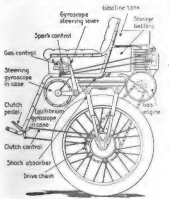
WHILE gyroscopes have been used to prevent ships from rolling and to keep torpedoes on their courses, it has remained for an Iowa inventor to apply the principle to a one-wheeled automobile to maintain its equilibrium in steering.

In this unusual vehicle, the operator sits above and forward of the center of the wheel, with a one-cylinder gasoline engine at the rear to balance his weight. With the engine behind him, the driver would have to stop every time an adjustment of the engine parts was necessary, which would not always be convenient. The inventor seems to have neglected to provide some form of folding step to keep the vehicle upright when the gyroscope is not running; but a stand somewhat similar to those used on motorcycles could easily be attached.

The drive from the one-cylinder gasoline engine to a sprocket on the pneumatic tired wheel is by means of a chain, like that used in motorcycle practice. The vehicle is less flexible than a motorcycle, however, since it has no form of speed-changing mechanism and must rely on a slipping cone clutch or spark and throttle control to give any desired speed changes.

The steering gyroscope is supported on two bell-crank levers, one on either side of the seat. When it is desired to steer the car to the right, the right-hand lever is pulled backward so that the gyroscope case is lifted up off the left lever support. The precessional movement in evidence will cause the machine to turn to the right until the gyroscope and its case is allowed to drop so that it is supported equally on both lever arms.

Both gyroscopes are mounted in vacuum cases, and are driven by current from a small storage battery carried on the frame supporting the seat, and between the seat and the gasoline engine. Whether or not the weight of the storage battery would seriously affect the economy of such a vehicle, and the distance which could be run without charging the battery, the inventor does not state.



The machine has but one wheel, which supports, on four forks, a platform carrying an operator's seat at the front and a one-cylinder motorcycle engine at the rear. The platform houses a balancing gyroscope mounted on a vertical shaft and run in vacuum by an electric motor

In any event, the invention embodies the use of interesting principles. One-wheeled motorcycles are always an attractive field for experiment and invention. Their number will undoubtedly increase rapidly.

Imagine the sensation of racing down the road on a one-wheeled vehicle! All the world's ahead, only the one wheel's underneath, and a man's free to career and careen as much as he likes—or more! No wonder inventors experiment.

A Sled Brake Which Will Not Throw You Headlong Into the Snow

SLED brakes seldom work satisfactorily. When applied, they either cause the occupant of the sled to plunge headlong into the snow or force the sled to spin around like a top. A brake recently invented by Jacob Blaszczyk, of Chippewa Falls, Wisconsin, overcomes these defects in a simple way.

The brake is not mounted on the side of the sled, as are most

To operate the brake, a handle which moves between wooden guides is pushed forward on anti-friction rollers

boy-made brakes, but is rigidly attached to the underside of the sled top. The brake end consists of a toothed steel plate, which is made fast, by means of a rod and strong spring, to a handle at the front of the sled. To operate the brake, the handle is pushed forward on anti-friction rollers which travel between wooden guides. This is done with the rider's feet, as he sits upright on the sled.

Cook a Breakfast for Six for One-fourth of a Cent

TO-DAY the question of fuel is a burning one, metaphorically as well as literally. In a series of very interesting tests recently conducted at the Ohio State University, natural gas was found to be the cheapest combustible. There are many places, however, where it is not available.

A breakfast which cost one-fourth of a cent to cook with natural gas, cost nearly three and one-half cents to cook with soft coal, two and one-half cents with coal oil, over three cents with gasoline and three cents exactly with electricity.

How Many Motion-Picture Tree-Top "Close Ups" Are Taken

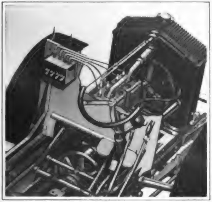
WHENEVER you are puzzled by the unusual in motion pictures, there are always two points to be kept in mind. The scenes are not taken in the order in which they appear on the screen, and continuity of thought takes the place of continuity in fact.

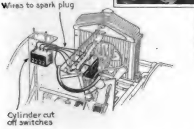
For instance, if you see a girl start to climb a tree and an instant later see her in the topmost branches, the thought is practically continuous and your mind imagines the rest of the climb. The accompanying photograph shows how such a picture was actually filmed. All of the scenes on the ground, before and after the heroine was supposed to have climbed the tree, were taken first. Then strips of planking were nailed to the tree and the tree-top "close ups" were taken.

The camera platform is mounted on a motor truck. Ground props prevent all vibration

Which Cylinder Is Missing Fire? Find Out from the Seat

THE invention shown in the accompanying illustration can be used either as a testing apparatus for shop work or as a permanent device to be placed on the dash of an automobile. The chauffeur can determine easily and quickly just which one of his engine cylinders is missing fire without getting out of





Showing the mechanism of the ignition-detector. Using it, the chauffeur can test his cylinders without getting out of the car

his seat or raising the hood over the engine. The offending cylinder is detected by shutting off the ignition circuit of all the cylinders except one and allowing this one to pull the others against compression. To shut off the circuits, little contact plugs on the front of a box on the dashboard are depressed by means of small handles which force any particular strip back against a bus bar at the rear. When this is done, the current is shunted from the plug through the lead and bus bar back to the current source through the usual ground wire. Naturally, if a particular cylinder is not firing properly, its power will not be sufficient to carry all the pistons over and against the combined compressions. Therefore, by allowing the current to pass through each spark plug, if necessary, the offending one can soon be located. If the cylinder is firing, as it should, the engine will run without help from the other cylinders.

Mandolin Music Via the Tuneful Molar

AT last someone has discovered what has ailed the mandolin these many years. With his trained architectural eye and his well-developed sense of what's what in ornamental designing, R. C. Petty, of Drumright, Oklahoma, has decided that the vitals of the instrument are in good order but the general contour of the thing is all wrong. Accordingly, he has invented an instrument which for beauty of line and lavishness of design is without a peer.

Exhibiting a marked degree of originality, he has chosen the human tooth for his model. Look at the accompanying illustration and you will see how faithfully this knight of the strings has followed the graceful outlines of the molar. But he has taken away none of the entrancing melodic quality of the instrument itself. In its new and more beautiful shape, the mandolin may be said to be even more tuneful, if such a thing is possible.

New mandolin design promises to make the human tooth famous

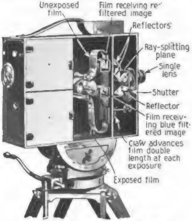
Mixing Colors on the Screen

A new way of obtaining motion pictures in natural colors

By Max Fleischer

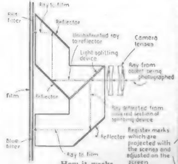
EVERYBODY knows that motion pictures appear to be alive because the eye is not able to tell when one picture is flashed on the screen and another takes its place. The phenomenon is known as "retinal persistence." In the Kinemacolor process of reproducing scenes by motion picture photography in actual colors, retinal persistence is relied upon to secure the color effect as well as the effect of motion. In the Kinemacolor process an exposure is made to rays that have passed through a blue filter, and then another exposure to rays that have passed through a red filter. Thus, blue and red exposures alternate throughout the entire picture. In order to obtain the effect of natural colors on the screen, it is obvious that the film must be projected at double the usual speed, simply because it has been made in the first place at double the usual speed. As the eye views the projected picture it is bombarded by red and blue images which succeed each other so rapidly that the colors are combined. A mixture of red and blue is the result. In other words, the screen receives two entirely separate colors in rapid succession and the eye is forced to mix them. Our eyes are fooled because they are slower than the projector.

This explanation is necessary in order to understand the basic principle of the new Technicolor process. Here two sets of photographs are also made, not at succeeding intervals, but simultaneously. These pictures are separated the distance of two pictures on the film, to allow room for double lenses used in projection. The registration of the colors is accurate, and the eye is not fatigued.

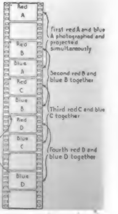


The motion-picture camera which takes two pictures simultaneously at the usual rate of sixteen per second.

Double photography is made possible by an ingenious light-splitting device which is located in back of the lens. The accompanying diagram explains the principle clearly. The light-splitting device is nothing more than a prism, the face of which has been coated with silver in numerous squares comprising exactly one-half of the total surface area. The balance of the surface remains transparent. One set of rays is



How it works.



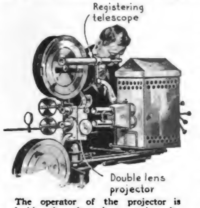
Above: The rays of light coming through the lenses are split into two parts by a novel form of reflector; part of the light passes through a red filter and part through a blue filter.

To the right: How the blue and red exposures appear on the film for projection.

reflected by the silver; the other passes through the transparent openings.

The film which is made by this process when it is projected is not a succession of blue and green pictures. The pictures are black and white. They represent, however, the red and blue color qualities of the original object photographed. Why, then, do they appear in colors on the screen?

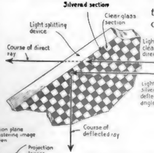
Study the accompanying picture of the projector and the answer is plain. The projector required is fitted with two lenses spaced two pictures apart. The upper lens is provided with a green-blue screen through which the images representing the red shades on the film are projected; the lower lens is provided with a violet-red screen which supplies the blue sensation. These two colors appear at the same time on the screen, one over the other. The two colors are accurately registered on the screen chiefly by observation of the general effect produced. However, it is not necessary for the operator to rely entirely on his judgment to secure registration. In one corner of each red film is a minute circle, and in the corresponding corner of each blue film is a very small solid circular spot. The operator shifts the pictures so that the solid spot on one film is centered within the circle of the corresponding film. These registration marks are so small that they cannot be detected on the screen. They are located by means of a microscope permanently attached to the projection machine. The images are shifted by an additional lens to avoid the distortion resulting when the entire main line system is shifted.



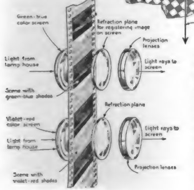
The operator of the projector is looking through a microscope in order to make the two sets of exposures register accurately on the screen

The two pictures which were taken at the same time by the camera are projected simultaneously, so that colors are actually mixed on the screen, but by a process akin to that which is used in making the colored covers on the POPULAR SCIENCE MONTHLY and other magazines.

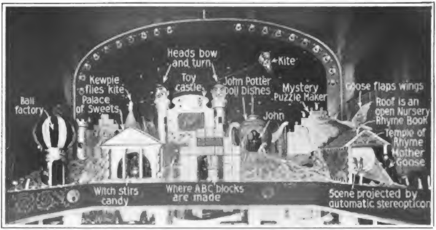
It is true that double the film length used in ordinary motion picture work is required. On the other hand, the rate of speed is that ordinarily adopted. The pictures are advanced, two at each shift, and sixteen two-color pictures are displayed every second on the screen, which is the average speed of all ordinary motion picture projections.



The light-splitting device consists of a glass plate part of which is silvered and part of which is transparent, producing a checkerboard effect. Some of the rays are reflected by the silvered portions and others pass through the transparent portions. The reflected rays strike certain parts of the film to produce one set of exposures, and also the transmitted rays strike other parts to produce the second set of exposures



The double lens system co-operates with the doubly exposed *film* to secure natural effects



This colorful display of mechanical toys filled the whole side of the court of a department store. It held crowds of delighted children spell-bound each day for weeks

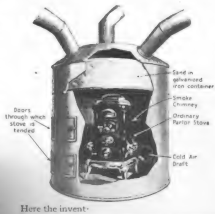
Mother Goose, John Potter, and All the Rest Attended Toy Town Show

WHERE is the mysterious land from which all toys come? New York children recently had an opportunity to look at it. A large department store put on a display showing all the characters childhood knows well, actually at work. Balls revolved, heads bobbed, "teeter-totters" see-sawed, a goose flapped its wi[illegible]

[illegible]our months' work [illegible]duction. All the [illegible]ally operated by [illegible]tric motor.

A New Cure for the Capers of Hot-Air Furnaces

FREDERICK E. JENKS of New Haven remedies the ills of the hot air furnace by placing a large tank of sand inside its top, and by using an ordinary coal stove for producing heat. The sand absorbs heat when the stove is hot and then radiates it uniformly after the fire in the stove has died down and the heat is needed.

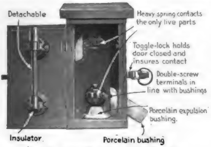


Here the inventor has placed a parlor stove inside the shell of a furnace. The idea seems to work well. The sand is just as useful in an ordinary furnace

Using stove furnace, a hod of coal keeps cottage warm twelve hours in zero weather

Removing a Fuse from the High-Tension Mains without Shock

MANY a lineman who has not taken the trouble to put on his rubber gloves has been severely burned while renewing a fuse that has "blown." A new "safety-first" fuse box, however, makes it possible for the most careless lineman to perform his task in safety.



The fuse simply swings out with the door, safely away from the dangerous spring contacts which are "alive"

The fuse proper is clipped on the cover of the fuse box. When the lineman opens the door, therefore, the fuse swings back with the cover and automatically disconnects itself from the dangerous spring contacts on the back of the box. The inspector removes the defective fuse and puts a good one in its place without going near those "live" spring contacts. The fuse and its parts are very similar to those ordinarily used and are operated automatically without opportunity to produce a shock.

A Bridge Built on a Single Line of Posts

IF you have ever crossed a country bridge which swayed and creaked ominously underfoot when the wind was high, and which looked as if the weight of the village "fat man" would be more than it could bear, it will not come as much of a surprise to learn that many bridges of this type are very hastily constructed. The one shown in the illustration took all of one whole day to build.

The novel point in the construction shown is that it rests on only one set of posts, which are set like a row of telephone poles, only nine feet apart. Each pole is supported by two braces, one on either side, and each has a cap on top. The walk boards are long and narrow. One board covers the distance, in length, between three posts.

This bridge, which is thirty-four feet from the ground, is built on only one line of posts. Each pole is supported by two braces, one on either side and each has a cap on top

Wasting Two Millions

Loss awaits the shipper who packs goods neither wisely nor well

This second-hand box gave up when it was called upon to carry heavy rolls of cotton warp

BEFORE the war, the loss and damage to merchandise on a single Eastern railroad cost more than a million dollars a year! This year it will reach two million dollars—a year in which the Nation is supposed to act as a unit in the prevention of waste. What is the reason? Simply foolish economy. Shippers are using cheap packing materials and weak or second-hand containers.

Is it a wonder the heavy bolts of cloth broke through this insecure, flimsy packing box?

Such a waste, says the Pennsylvania Railroad, is indefensible. The only way to avoid it is to pack goods properly in strong containers and to mark them plainly, all old marks having been previously removed. Co-operation is also asked of receiving clerks, agents, foremen, car inspectors, loaders, truckers and car packers, that the waste may be eliminated at once.

Axes have been discovered shipped in paper boxes, potatoes and onions in flimsy crates, dangerous solutions in leaky barrels and food stuffs in second-hand containers of paper. In one instance, a shipment weighing nearly fifteen hundred pounds was packed in a second-hand box made of one-half inch lumber. It fell to pieces *en route*. Other instances of careless packing are shown in the photographs.

Obviously cheap containers lose a shipper more than he saves. Worse than the mere

Iron castings bulge out of thin gunny-sacks at a wayside station

Pack axes in paper boxes and this is what happens

damage to his product, or its total loss, is the ill feeling on the part of the customer that is engendered. When a man has been waiting long and anxiously for needed goods, to have them arrive all broken up and useless, simply because the shipper was too lazy, or too economical, to properly box them, naturally results in strained relations.

Crates of onions and barrels of potatoes broken in transit; the light lumber could not stand the weight

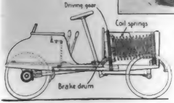
A Spring-Driven Automobile for the Youngsters. It Runs Just Like Dad's

HERMANN F. CUNTZ, an engineer who has been connected with the automobile industry from its very inception, has invented a mechanically-driven toy automobile which ought to please a youngster who wants playthings that resemble as closely as possible the machines of every-day life. Mr. Cuntz has developed a machine with spring power, controlled like a real, full-sized automobile.

The little "chauffeur" on cranking this automobile, winds up a set of six strong springs. A band brake locks the springs, so that the automobile cannot run away. When the young driver takes his seat, a brake lever attached to the seat cushion is operated. The lever releases a brake band from the brake drum so that the automobile is ready to start off just as soon as pressure is put upon the starting pedal. Pressure upon this pedal loosens a second brake band and allows the springs to turn the rear driving wheels by means of the transmission gearing. Then off Johnny goes for his drive!

The motor is sufficiently powerful to carry the automobile a distance of fifteen hundred feet. Nevertheless, the automobile is perfectly safe for a child. Should Johnny stand up carelessly, a spring returns the lever attached to the seat cushion, and the motor is stopped by the brake. Moreover, the speed limit can never be exceeded, since the driving gear is so arranged that even when the powerful springs are fully wound, only a nominal speed will be attained.

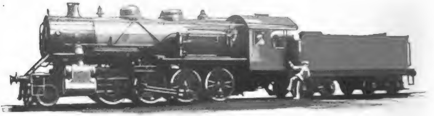
Another interesting feature of the automobile is a lever attachment which enables the motor to be thrown out of gear. This makes it possible to coast down a hill and thus save power.



The nest of six springs can drive the automobile a distance of fifteen hundred feet. The controlling levers are operated just like those on gasoline automobiles. Baby has a delightful ride

Giving France the Locomotives She Needs

Six hundred and eighty engines and six thousand cars are ordered for France



A locomotive of American design, intended for service in France. The French tracks, however, require smaller and lighter engines than those with which we are familiar

WITHOUT an adequate system of railways to move troops and supplies to the front and distribute ammunition to the big batteries on the firing line, fighting, as it is done nowadays, would be an impossibility. Germany has made the world marvel at her railway system. Over night she has moved vast quantities of troops from one front to another. Never before has the necessity of rapid railway transportation been so imperative as in this present war.

France, of all the Allies, is the nation most in need of railways just now. Shortly after this country declared war, the Government placed orders for six hundred and eighty engines and six thousand cars, all of them to be used behind the battle line in France. Twenty days after the order was placed, an engine and a car were ready for shipment. The accompanying photographs show two designs of engines which are being sent abroad in very large numbers.

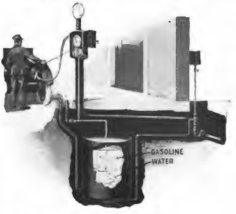
Since French tracks will not stand the weight and length of standard American rolling stock, the engines are much lighter and smaller than those we usually see in this country. They are of the type of 1866, but the design closely follows modern American practice, with the exception that the couplings and buffers are made to suit French standards. Designed to make long runs and to handle heavy supply and troop trains, these engines can traverse the short curves of French roads and run on rough tracks. A piping system is placed at each end of the locomotive to wash the rails with streams of hot water and steam when they are covered with mud. Another departure is a water-lifting valve by means of which the tender tank can be filled from streams or ponds alongside the track.

Smaller locomotives adapted to rough trackage and sharp curves such as are met with in the hasty construction of war time

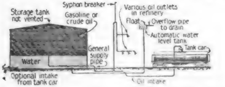
In addition to the large and small locomotives already made for foreign service, the Government has placed an order for gasoline locomotives. All railway equipment sent from this country will be painted battleship gray to make it inconspicuous. American motor trucks and trailers equipped with flanged wheels will be used in connection with the standard equipment. It is understood that five engineer regiments will take charge of railroad operations for the army.

The big locomotive works the country over are loaded down with orders. France can be assured of efficient aid from America as far as locomotives go.

Conserve Your Gasoline—By Pouring Water Into It



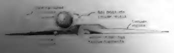
In spite of the fact that gasoline is becoming so scarce, until lately refiners have paid but little attention to the immense amount they lose through evaporation from storage tanks. At "tank farms," as they are called, it is not uncommon to see a fog over the tops of the tanks due to gases escaping from vents. Usually the best grade of gasoline escapes, which, if it were recovered, could be used to enrich many gallons of ordinary kinds. Vacuum systems to recover this gas have been tried, but as a rule prove expensive and not very practical.



Above, Farr system applied to a garage gasoline reservoir. At left it is controlling a much larger supply tank

Now comes Frederick G. Farr, of Detroit—where they use lots of gasoline—with a system designed to prevent all this waste. He would fill all space in gasoline and crude oil tanks with water. Oil and water do not mix, of course—and water always assumes the lower level. Thus the oil is always pushed up against the top of the tank where it may be drawn off. Should gases form, they do not burst the tank—but their pressure simply pushes on the water, causing it to overflow through an "automatic water level tank" into a drain. When some of the oil is drawn off, water takes its place from this tank, a suitable float valve permitting more to enter from the plant water system, or other source.

You Can Now Practice Putting In Your Own Parlor



Around the recess are flexible bristle or cardboard filaments which counterfeit the action of grass

During stormy weather, or in the winter, it will no longer be necessary for the golfer to forego his putting practice. Eugene McLean Long, of New York, has invented a device for catching and holding a ball in such a manner that when you use it you almost imagine you are on a putting green instead of on the parlor floor.

The indoor putting green is a circular device having a recess in the center. The recess is surrounded by flexible filaments which tip when struck like blades of grass. The underlying idea is to reproduce outdoor conditions as closely as possible.

Canopus—A Mighty Celestial Furnace

It is so far away that we see it by the light that left it in the 15th century, and it is 139 times bigger than our Sun

By Scriven Bolton, F. R. A. S., M. B. A. A.

IF we took up our abode at a distance equal to one of the nearest stars, say Alpha Centauri, long before arriving there our world would be totally invisible, even if we carried with us a powerful telescope. The ratio which it bears to the visible universe of stars is inconceivably less than that which a single drop of water bears to all the oceans of the world united.

The immensity of the stellar universe will never be comprehended by our finite intelligence. Let us, however, contemplate the intervals of time required for light to bridge the awful gulfs of space around us. Traveling at the rate of at least 188,000 miles per second, light takes four years to reach us from the nearest bright star. Yet the velocity of that light is sufficient to circuit the earth at the equator no less than seven and a half times in a single second. The light from many stars occupies hundreds and even thousands of years in the journey; hence we gaze upon them to-day as they were centuries ago, and if at the present moment they ceased to shine, our senses would remain unnotified of the fact till centuries hence. Further, it has recently been ascertained that stars in the Magellanic star cloud are so very distant that their light requires 30,000 years to reach us! A striking witness to the inconceivable dimensions of what may be termed a microscopic corner of the heavens was forthcoming in 1901, when the new star Nova Persei suddenly burst forth. The rays of light thus propagated took many months in reaching and finally illuminating the nebulous region situated "locally" one might say.

The question of the size of different bodies poised in this infinite space is one which frequently arises, and the slumbering sense is startled on learning of the existence of spheres hundreds, thousands, millions of times larger than our globe. Situated as we are near the center of the Milky Way, that beautiful soft track of light which forms a complete circle of light round the earth, we hold a position in the heavens favorable to an inspection of our neighbors. We are apt to be mislead by the assumption that the brightest stars represent those nearest us. Astronomers have found that distances vary quite irrespectively of brightness, for throughout space we find big and little stars strewn alike in haphazard fashion.

How Small Is Our Mighty Sun!

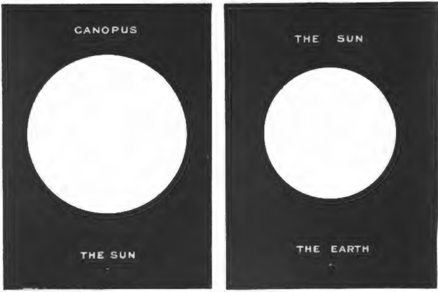
As in many things common to ourselves, appearances are often decidedly misleading. We might say that our sun is larger than other suns. Careful measurement, however, tells us that our luminary represents just an average sized member of the celestial host. But to say that it attains a diameter of 865,000 miles is a bare statement which fails to awaken an adequate conception of its vastness. If a track were laid along its equator, and a train were to travel thereon at the rate of sixty miles an hour day and night without intermission, five years would be occupied in completing a single journey. The sun's comparative diameter might be illustrated by placing 109 marbles in a row, each one representing the earth. A colossal globe no doubt. But we have only to look around at some of the well-known stars to find the sun's dimensions surpassed many times. Take Sirius, the Dog Star, whose diameter is six times that of the sun. At a more remote distance, so remote that its distance cannot be correctly ascertained, is Spica, a first magnitude star, which, judging from its bright light, must be a sphere at least fifty-five times greater in diameter than our sun. At a similarly inconceivable distance is the well-known star Rigel, which Sir David Gill stated must possess a minimum diameter of seventy-five times that of our luminary.

What is the Biggest Star?

In ascending to greater dimensions the

Canopus — Mightiest of Suns

Chiefly of incandescent hydrogen, and probably gaseous to the core, the immensity of Canopus, a first magnitude star in the southern hemisphere, is here shown as it would appear in the sky were it situated even twice the sun's distance from us. Were it ever to come much nearer the earth, we would be scorched by a terrible heat that would kill everything



Size of Canopus (largest star known) compared with sun and earth. Canopus has a diameter 139 times greater than the sun's, and sun's is 109 times the earth's. How little we are!

inquisitive mind asks:—How large is the biggest star known? After years of tedious and elaborate work, astronomers have found that the southern hemisphere possesses a star, called Canopus, which, in point of size, certainly surpasses that of any star yet discovered. It is an appalling object. Although only a fraction of a magnitude less in brightness than the brightest star Sirius, it nevertheless occupies a "back seat" in the heavens. Its distance cannot be less than a hundred times that of the nearest bright star Alpha Centauri, which is similar in *apparent* brightness. Thus we have two stars of the first magnitude but situated in vastly different places in the universe. The rays of light which we are to-day receiving from Canopus were propagated from this giant sun in the fifteenth century. Dwellers on this earth of ours about 450 years hence will see it as it is at the present moment.

In Canopus we have a traveling celestial furnace, emitting 50,000 times more light than does the sun. Its motion through space amounts to something like 1,000 miles every minute. Its stupendous diameter is 139 times that of the sun's, being equivalent to over 120,000,000 miles. Its outer layers are composed chiefly of glowing hydrogen. Not improbably its entire structure, right to the core, represents an incandescent gaseous globe, a remark which may apply equally well to the majority of stars.

We cannot conceive conditions under which matter could exist near the center of such a huge body. On our miniature earth, for instance, pressure due to gravitation in the oceans, amounts to the respectable figure of seven tons every square inch. If now we consider a globe the size of Canopus to be constituted of material having a mean density equal to that of water, at the center of such a globe there would be the pressure of a column of water upwards of 60,000,000 miles in height, besides the corresponding enormous pull of gravitation. If we regard this pressure in terms of terrestrial gravitation it reaches over 67,000,000 tons per square inch. Furthermore, we have the inconceivable heat to contend with at the center of such an enormous body, which must be greater proportionally than at its surface, just as the earth's heat is greater at its center than at its surface.

When the Fighting Relaxes the Bayonet Becomes a Periscope

STUDY the accompanying illustration and you will see what a British Tommy can do with his bayonet, by exercising some cleverness and ingenuity. At the point of the blade is affixed an ordinary trench mirror. By leaning back against the parapet the Tommy can see the outskirts of No-Man's Land and the enemy's trenches in his makeshift periscope. Beside him are two observers.

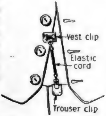
By attaching an ordinary trench mirror to the end of his bayonet blade the Tommy has a makeshift periscope

Why Is the Sun Bigger On the Horizon?

DURING the day when the sun is high, nothing is near it to compare it with in distance, so we think it is small; but when we see it on the horizon with houses and trees and church spires intervening, we believe it to be large. How often have you swallowed this explanation as the truth? To be candid, it is a scientific fib. To prove it, look at the moon from behind a lace curtain or from behind a bush. It will appear not a whit larger.

The real explanation of the sun's apparent dilation is this: The sun is enlarged at sunset because the air magnifies it. Of course the air is in a condition to magnify objects all day. But when the sun stands high, we look up through only a thin layer of air, whereas at sundown our eyes have to pierce the entire depth of the atmosphere—multiplied at least sixteen times. This accounts for the enlargement of the sun. Dust and heated air appear to be the causes of the magnification. Thus the phenomenon is more noticeable in summer and autumn, our dusty seasons.

A Simple Supporter Takes the Place of Suspenders



Showing the elastic band with the convenient clips

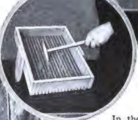
This supporter holds the trousers firmly to the vest

WHEN both trousers and vest are worn without suspenders, the trousers all too frequently sag below the lower edge of the vest, exposing the shirt. This is very unsightly. To avoid it, William Baake, of West Hoboken, New Jersey, has invented a supporter which fastens the trousers securely to the vest and at the same time allows the wearer full freedom of movement.

The supporter is a simple elastic strand with clasps at both ends, one for the vest and the other for the trousers. With the vest buttoned, the clasp is invisible.

Do It with Tools and Machines—a Baker's Dozen of Efficiency Devices for the Mechanic and Factory Man

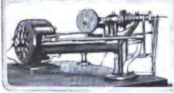
An especially constructed frame for holding canvas which protects persons from flying bits of pavement blocks or other stone



This counter attached to a machine accurately records the parts turned out

In the upper circle, an arrangement which enables a one-armed man to pick up nails with a magnetic hammer

Below, a clamp to hold a diamond cutter for truing emery wheels



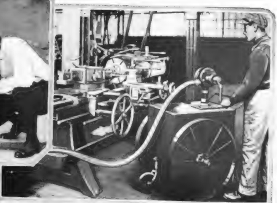
This model maker's lathe which is driven by motor, is fitted with necessary attachments for making fine phonograph needles

Device for forcing a steel ball into metal to test the hardness of steel

A chain drag used by an industrial school for running shucks and ensilage into a silo. It is run by a belt from a motor or a gasoline engine

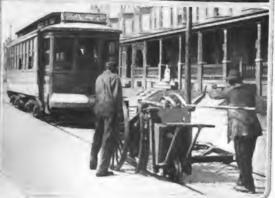
At the left, a trailer factory truck in which the front wheel attached to a handle, dis[illegible] and can be used on [illegible] trailers

Do It with Tools and Machines

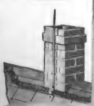


The joint filler should not be flush with the street. This shovel leaves a half inch of the metal extending

In upper right hand corner, a portable shop tank for delivering oils and compounds to machines

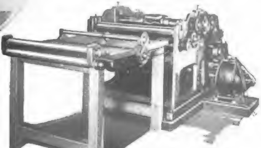


At right, a new type of lightning rod, made of numerous copper wires woven into a tight web



Car rails wear quickly at a spot slightly ground out by slipping wheels, but with this portable grinder the rail's surface is quickly smoothed to the level of the depression

Below, a machine which punches or blanks uncured rubber stock from the rubber calendars, and which is to be used to manufacture rubber shoe heels, water bottles and other articles



Nothing is more annoying to the steam fitter than to have a pipe wrench slip when turning a pipe. Above, a large wrench which a man can trust to hold his weight

A new searchlight has been brought out by Edison which operates on a six-volt storage battery. Focus may be altered to throw either a wide or a concentrated beam. It is extremely useful at fires

Fighting Fires With Searchlights

WHEN Thomas A. Edison's phonograph works at Orange, New Jersey, burned some time ago and he saw firemen confusedly fighting the flames, handicapped and blinded by the lack of light, his active mind grasped the opportunity to solve the fire fighting problem, and as a result we are indebted to him for the portable electric light called by its inventor the "sunlight of night."

This portable searchlight consists of a light, easily handled case of indestructible steel, carrying an especially designed set of Edison's storage cells and having attached to it a powerful electric light with a big projector and intensifying reflector. When the battery is fully charged, the lamp will project a light of 6,000 candle power for 4.5 hours, or 2,200 candle power for eight hours. The lamp and case weigh forty-one pounds and they may be carried by hand or attached to an automobile or fire-engine.

The rays can be focused upon one spot to shed thousands of candle power of concentrated light upon a single window, or the beams may be quickly changed to spread over a wide area. It can be used with perfect safety in the presence of gasoline, broken gas pipes, chemicals and other explosive fumes. This new light is already finding a wide use, not only in fire-fighting, but also wherever light in abundance is required and where it is neither possible nor convenient to run service wires. Where much guarding of factories must be done, as at present, the lamp is likewise of great value.

A Car For Use Where Man-Power Is Cheap

THE odd combination of a man propelled vehicle, with street car rails is to be found in Otsomiya, Japan.

Man-power being cheaper, in that section of Japan, than horse-power, the street-car magnates of the town do not allow humane considerations to interfere with their dividends.

The car shown in the illustration has seats for four passengers. The man behind the car is the human motor that propels the conveyance.

The passengers must have true Oriental patience, because this method of transportation cannot be exactly speedy.

Japanese street car is propelled by a coolie's shoving one foot along the ground

Firing a Cannon From a Cannon

An inventor's ingenious plan to bring down aircraft flying at great heights

ONCE upon a time, so an old fairy tale runs, a lunatic wanted to bombard the moon. He invented a shell that was in itself a cannon. During its flight, this projectile-cannon would discharge another shell, which was also a cannon. And so by firing successive cannons within cannons the lunatic thought that he might cover the space of 260,000 miles that separates us from our satellite.

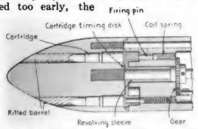
The Gun Within a Gun

A shell like that which Mr. Graham has conceived can be timed to discharge its bullets efficiently, far from its target, unlike shrapnel. The bullets do not lose in velocity, thanks to their elongated form and their rotation. Their velocity is the sum of the shell's velocity and their own. Were it not for the centrifugal action of the shell, they would not scatter. The firing can be timed so that at least one volley will scatter properly.

Now that cannon must be fired at elusive aircraft, this ancient idea has been revived in earnest. Airplanes must be fired at point blank, there is neither opportunity nor time to figure out the exact range. On the other hand, the explosion of the shrapnel-shell is not so easily timed. The hail of bullets that follows the bursting of shrapnel meets so much more air resistance than the shell itself that not only is the scattering effect too great, but the striking force is too small. If by any chance the explosion be timed too early, the scattering effect is not sufficient and the airplane is not winged as a shot-gun wings a snipe or a quail.

Andrew W. Graham meets this difficulty by inventing a shell that is not merely an envelope to hold bullets together for a certain distance, as in shrapnel, but which, like that in the fairy tale, is a gun in itself, and a very powerful Gatling gun at that.

The projectile is pierced with a dozen or so of rifled channels, each constituting a barrel loaded with a regulation rifle cartridge. The inventor has provided a lock and firing pin for each hole and a clock-work mechanismto fire simultaneously series of barrels or holes. This mechanism seems a needless and hardly feasible complication. Such is the concussion in a shell when it is fired from a gun tnat the shrapnel balls must be cemented together. How will clock-work endure a shock that even solid balls cannot withstand? The fuse used in shrapnel, a marvel of accurate mechanism, adapts itself to setting off the charges of the rifled passages of Mr. Graham's shell. By thus discarding the clock mechanism, the barrels or rifled holes can be made longer, which means greater accuracy of fire.



The ordinary fuse used in shrapnel sets off the charges of the rifled passages of the shell

Submarines to Foil Submarines

The Germans showed us how to meet the submarine menace and we haven't learned the lesson they taught us yet!

By Simon Lake, M. I. N. A.

(Mr. Simon Lake, the author of this article, ranks with John P. Holland as a pioneer in the development of the submarine. His reputation as an inventor and builder of submarines and his vast experience as an advisor on submarine questions to the United States Government as well as to the leading European powers entitles the following suggestions of his to very serious consideration.—Editor.)

DURING the months of September and October, the German submarines sank *only* twenty vessels a week, according to the dispatches. *Only* twenty ships per week! How many realize that this is the equivalent of 2,808,000 tons in a year, assuming that the average vessel is about 2,700 registered tons? We actually congratulate ourselves that *only* about three million tons a year are sent to the bottom by a method of warfare against which the world is at present powerless.

Despite the five thousand submarine hunting and destroying vessels which Great Britain is reputed to have in the waters of the North Sea and the north Atlantic, despite the nets strung across narrow straits, despite the arming of merchant ships with powerful naval guns, despite convoying torpedo boat destroyers, despite all the experience gained in two and a half years of submarine warfare, the neutral and belligerent seafaring powers of the world are helpless to protect their shipping. The best inventive brains of two hemispheres have been racked in the effort to sweep the German menace from the high seas. And what is the result. *Only* twenty ships a week have been sunk on an average in the months of September and October!

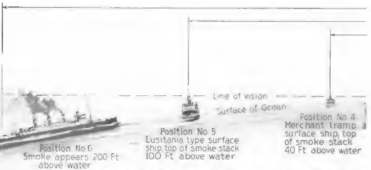
It is obvious that this cannot go on if the United States and her allies are to win the war. We have decided that we must build ships, more ships and still more ships—build them faster than they can be destroyed by submarines. To me, the process is like shoveling coal into a fiery furnace in the vain hope that in some Providential way the fire will be choked. The public and some of our officials lose sight of the fact that the German fleet of submarines must be increasing by leaps and bounds, probably at the rate of about one hundred and fifty vessels a year. If the sinkings are fewer in number than they were, this is due to the fact that today merchant ships, like hunted beasts, take devious courses.

It is not likely that the lost ships will diminish in number; artful dodging on the high seas has its limits. Any device available to a surface ship for detecting and destroying submarines is equally available to the submarine for the detection and destruction of the surface ship. In such competition, the odds are immensely in favor of the submarine; it has the power of becoming invisible at will, while the surface ship is always visible and therefore vulnerable. The nets, shields and protective walls, with which one class of inventors would surround a surface ship, are useless. They slow down the speed so that the ship becomes an easy prey for mines planted ahead by a submarine. I am convinced, moreover, that no object can be made to float on the surface of the sea that cannot be destroyed by the U-boat. I do not believe that any way will be found which will make travel safe for surface ships until a method of seeing through the water for distances of several miles has been perfected, so that submarines can fight each other beneath the surface.

When the Germans sent the *Deutschland* to the United States, they taught us a lesson which we have failed to learn. Here is a ship which made two successful voyages to the United States under conditions that were the severest that could be imagined for a belligerent cargo-carrier.

Loading a Lake Double-Hulled Cargo-Carrying Submarine

In Mr. Lake's opinion, the cargo-carrying submarine of low speed is the only type of vessel which can escape the German U-boat. She has low visibility and is able to disappear. She has all the qualities possessed by her enemy. She may beat him at his own game. Mr. Lake maintains that "vessels of the ordinary type will in no way suffice to meet the great problem which today confronts the democratic nations of the earth. They must and will eventually come to the point where they will adopt the submarine to beat the submarine"

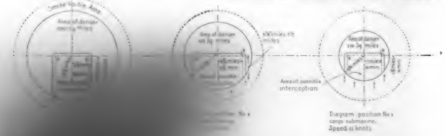


How the Submarine Takes Advantage of Her Low-Lying Hull

This diagram, shows the comparative visibility of vessels when seen from a military submarine and gives the distances at which the various parts of a large ocean steamer such as the Mauretania, with smoke-stacks extending one hundred feet above the surface of the sea, would be visible to a distant observer fifteen feet above the surface. Assume that the Mauretania is making her maximum speed of about twenty-five knots. By referring to the diagram it is seen that her upper works become visible above the horizon at a distance of eighteen and three-eighth miles from the periscope of the submarine. By using his range and direction finder, the submarine commander can determine the course of the vessel and figure out just when and where he can intercept her (position No. 5). In the case of a slow tramp, the smoke from the stack will first betray her approach. Her smokestacks are probably not over forty feet above the water level; therefore, if she were making the same course as the high-speed ship, it would be observed by referring to position No. 4 and the data there given, that the submarine at a speed of ten knots has more time to get nearer the course of the approaching ship and can have more time to calculate the enemy's speed of approach and

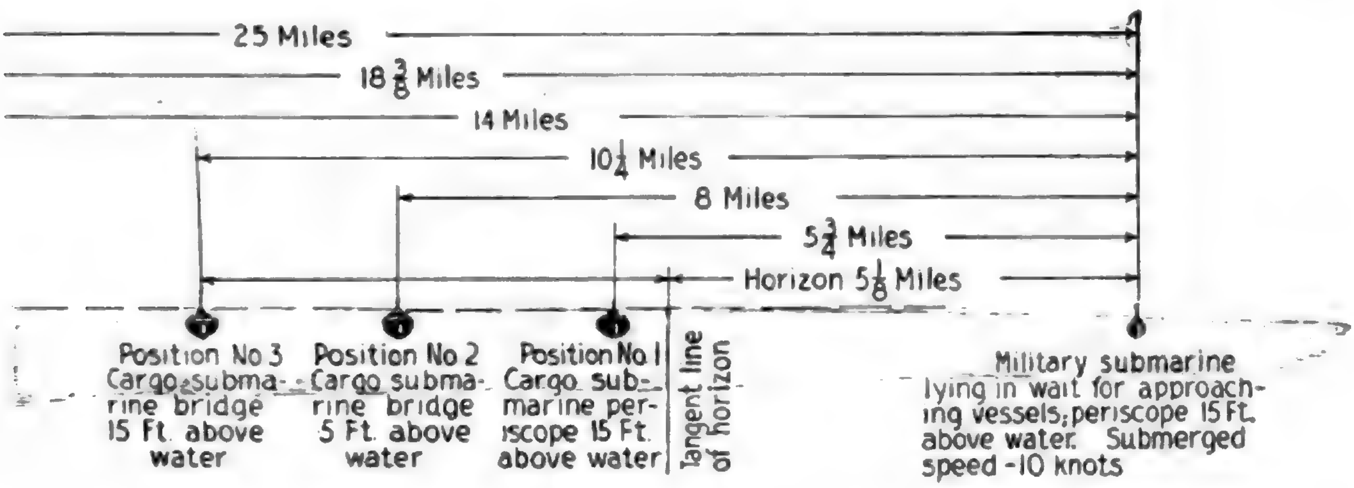
She eluded not only the hundreds of vessels which swarm in the waters surrounding Great Britain and which are constantly on the watch for submarines, not only the seaplanes and dirigibles which patrol the British coast, but also the British cruisers on the Atlantic seaboard of the United States. No vessel spoke her on the way. She entered Baltimore and New London with dramatic unexpectedness, unloaded her coal-tar dyes, shipped a new cargo of nickel and other German necessities, and calmly sailed for home.

In my judgment the only way in which we can thwart the submarine, the only way in which we can continue to send much-needed fuel, food and supplies to our Allies is the construction of large merchant submarines like the *Deutsch-*



...ing Submarine Can Cross the Atlantic Ocean

...a tramp, for instance,—the submarine freighter is ... she has the ability to submerge in less ... two minutes. Moreover, it is hardly likely ... will be attacked without warning for fear ... be a friendly military submarine. When ... she could navigate entirely on the ... a freeboard of fifteen feet, in which ... she can make a speed of eleven knots as



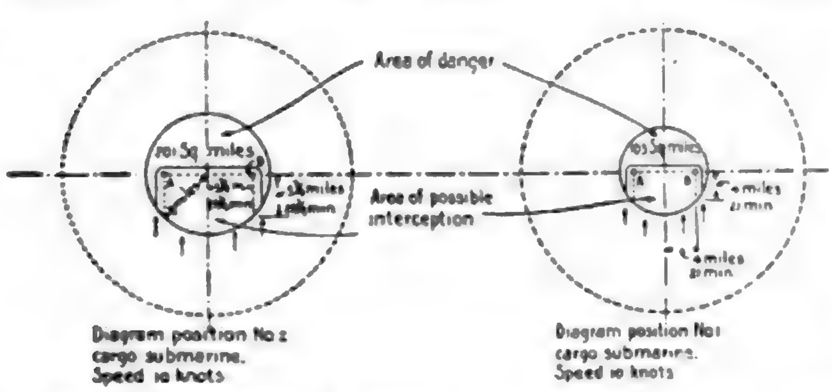
and Keeps the Big Ship in View While She Is Herself Unseen

direct course than if she were intercepting a fast Mauretania. Assume that this approaching slow-speed craft had no solid opaque portion extending over fifteen feet above the surface of the water, as in the case of the cargo submarine shown in position 3. She would pass the waiting submarine below the horizon, and the intervening round of the sea surface would prevent the submarine from seeing her. She would pass by unseen and in safety. In the various positions here shown, the submarine is assumed to have a submerged speed of ten knots. It is evident that practically one hundred per cent safety would be secured, could cargo-carrying submarines cross the ocean and remain invisible during the entire journey. This is, of course, impossible, because there is no means of supplying sufficient power for long under-water voyages without drawing on the upper air. But the diagram shows that a cargo-carrying submarine running awash, with her periscope and air-intakes alone above the water line, may approach within about five and three-quarter miles of any waiting military submarine without danger of being seen; for her betraying wake would be far, far below the horizon of the most watchful, ruthless enemy submarine afloat.

land. I can see no sense in building million dollar ships, loading them with several million dollars worth of cargo and sending them out to be sacrificed, when absolute immunity from attack can be secured at an additional first cost of not over two hundred and fifty thousand dollars per ship, or about eight per cent of the value of the ship and cargo (less than the present immense insurance rate on one voyage to England). For a supposedly inventive and progressive people, we are curiously prejudiced. Here are the Germans with their reputation for stolidity and slow-thinking successfully attacking very much the same problem with a boldness and an imagination which they themselves attribute to Americans. And we—we seem to be paralyzed by a conservatism inherited from our English ancestors.

The truth is that the submarine is a mystery to our shipping men. It takes a combination of liberal-mindedness and special knowledge to set a fleet of merchant submarines afloat. Despite the example of the *Deutschland*, despite the enormous profits which that vessel admittedly made for her owners, we still go on building surface ships, many of which must inevitably succumb to German submarines.

When our shipping men and our naval authorities realize the importance of invisibility and learn that the submarine is the least visible of all vessels, perhaps the rational solution of the problem here advocated will be attempted. The only effort at present used to secure invisibility is to be



Without Danger of Being Torpedoed

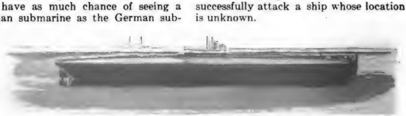
in position No. 3. This increases the danger area to about three hundred and thirty square miles, about three times the danger area shown in position No. 1. But as the area to be covered by the military submarine on the high seas far from land is also much greater, the real danger would be proportionately less than the lower visibility in a more thickly infested zone might lead one to suppose.

found in the use of the smoke screens advocated by the Government. Smoke is exactly what the German submarine commander is looking for. The sea captain obliges him by throwing overboard a fuming box made according to Government specifications. The submarine submerges in advance of the smoke, rises within the smoke pall, gages the distance of the surface vessel with her several detectors and then plants one or more torpedoes successfully. Over fifty per cent of the vessels attacked are sunk. The smoke even hides the wake of the torpedo itself; it removes the only chance to escape which the vessel might have.

I have illustrated this article with a few diagrams showing the advantage of various types of vessels in evading the submarine. The captions beneath the diagrams will explain the points illustrated. Here, it may be stated as a general principle, that visibility and speed depend upon elevation above water-level. When the sun or moon sinks beneath the horizon they cannot be seen. Neither can anything else be seen which is below the horizon. Such is the curvature of the earth that a hill of water intervenes.

It is obvious that absolute safety could be attained if a submarine cargo-carrier could travel entirely under water. That is at present impossible for good technical reasons. But a cargo-carrying submarine running awash, with her periscope and air-intakes just above the waterline may approach within about five and three-quarter miles of any waiting military submarine without danger of being seen. Her wake would be below the horizon. Such cargo-carrying submarines can be built and can cross the Atlantic Ocean in this condition, at a speed of about ten knots. If a sharp lookout is maintained, they have as much chance of seeing a German submarine as the German submarine has of seeing them. By the application of certain tried devices, which I do not feel it proper to divulge at this time, but which are within the knowledge of our Government authorities, in my opinion, the range of visibility can be reduced to less than one mile. The cargo-carrier can become entirely invisible by submerging. If she travels with a freeboard of five feet, she will become visible to a German submarine when she approaches within eight miles. In two minutes, she can dive under water. It is hardly likely that she will be attacked without warning lest she be a friendly submarine. She will be warned by wireless, sound, or other signals used by German submarines to communicate with one another. Her one business is to deliver her cargo and not to communicate with or expose herself to either friend or foe. When far from land, she can follow the *Deutschland's* example by navigating entirely on the surface with a freeboard of fifteen feet. In that condition, she can make a speed of eleven knots without the slightest difficulty.

Sooner or later it will be recognized that the Germans are carrying on their submarine campaign, not in a haphazard fashion, but systematically. Every ship sighted by a submarine is a marked craft. Even if she is the fastest vessel afloat, she may speed unwittingly into a trap set for her by wireless. If she cannot disappear, she has no real ability to escape. On the other hand, the cargo-carrying submarine of low speed has both these advantages. She has low visibility and she can submerge quickly By the simple expedient of descending beneath the waves, she becomes invulnerable She has the most valuable attribute possessed by her enemy, that of becoming invisible. You cannot successfully attack a ship whose location is unknown.

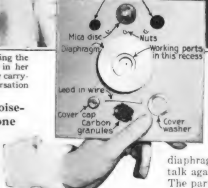


A Lake Submarine Cargo Carrier

It carries 7500 tons dead weight of cargo and can safely be navigated to depths of three hundred feet. By eliminating the top hamper and deck house used on ordinary surface vessels, the hull weights of such a submarine are only slightly in excess of the hull weights of a box-shaped, surface, cargo-carrying ship.

The girl is holding the bare diaphragm in her hand and easily carrying on a conversation

Below: The parts of the transmitter. Simple construction is possible since outside framework is unnecessary



The instrument can be submerged in water and it will still work, as illustrated above

At Last! A Noiseless Telephone

TRANSMITTER inventions there have been without end, but one which promises to dispose of side tones is being put out by a Chicago company. Side tones are troublesome hums, rattles, jars, and vibrations which make it impossible for a person to carry on an uninterrupted conversation. The principal cause for the presence of these extraneous noises is the fact that the whole outer case of the transmitter is receiving the sound vibrations; and, since the inner parts of the instrument are all held and trussed in place by crosspieces fastened to this case, the result is an interclashing of noises which cannot help but interfere with conversation. Every piece of metal—or object, has its own natural period of vibration; that is, it is peculiarly susceptible to certain sound pitches, or other vibratory disturbance, and thus it responds readily when these pitches are reached. Sensitive as a transmitter is, it takes notice of all these vibrations.

The Chicago invention would get around these difficulties by attaching the working parts of a transmitter to the diaphragm (that round disk you talk against), leaving the case free. The parts are small, and consist of the usual carbon granules between two disks. Aside from being free from side tone, the new transmitter is said to be remarkably sensitive. It can be submerged in water without in the least interfering with the conversation.

Even Milk Bottle Openers Are Problems in Mechanics

A MILK-BOTTLE opener which does not spill the milk, has been invented by Oscar Frank, of Cleveland, Ohio. The sharp pointed prong juts out at an acute angle from a little flat bar. When the prong pierces the cap, it does so in an almost horizontal direction. The cap is thus pressed against the side of the bottle and not toward the bottom. The lift of the cap meanwhile takes place as it slides up the incline of the prong, and the contents of the bottle are not spilled on the hand.

The opener is worked sideways and no milk is spilled from the bottle

A New Portable Electric Light for Manhole Work

NO longer will it be necessary for workers in sewer, telephone or electric conduit manholes to grope their way in the darkness or to burn their fingers with the exposed flames of candles or kerosene lamps. A large Eastern electric concern has just brought out a portable lighting outfit which weighs only forty pounds and which is provided with two twelve candle power lamps which can be lighted at the same time for ten consecutive hours.

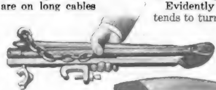
Using the portable lighting outfit, which weighs only forty pounds, for manhole work

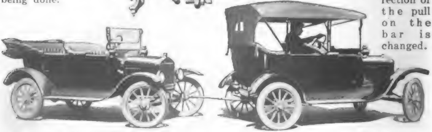
The contrivance consists of a small metal case inside of which is fitted a little five-cell storage battery which can be allowed to stand idle indefinitely in any condition of charge or discharge. Both of the electric bulbs are on long cables and are provided with wire guards and metal shields to concentrate the light on the work being done.

How One Man Can Both Tow and Steer a Disabled Automobile

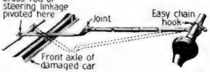
A NEW draw-bar towing device enables one man to both tow and steer a disabled automobile to the nearest garage for repairs. The unit is designed particularly for use in connection with Ford automobiles. It consists of a hinged two-part rod which is attached to the rear axle of the towing vehicle by means of a chain, and to the front axle of the damaged car by means of a special clamp and set screw. The rearmost part of the rod, made of a flat bar, differs from other types of towing units in that it extends back of the axle of the towed vehicle and is attached to the cross rod of the car's steering linkage.

Evidently the draw-bar rod tends to turn the front wheels of the towed vehicle as the towing vehicle turns a corner and the direction of the pull on the bar is changed.





In center above: The tow-bar collapsed to fit into the tool box. Directly above: The tow bar in use



At left: The rear part of the bar pivots about the clamp over the front axle of the damaged vehicle

Cleaning Five Hundred Blackboard Erasers at a Time

EVERY school teacher knows how difficult it is to keep the blackboard erasers clean, and to prevent chalk dust from being thrown out into the air of the school-room, where it must be breathed by the pupils. To remedy this, a machine has been invented which cleans five hundred erasers without throwing dust into your eyes and nose.

It consists of a revolving drum of heavy wire netting or perforated iron, inclosed in an outer casing. The erasers are placed in the drum, which, as it revolves slowly, bumps them about and extracts the dust. At the same time, a rapidly revolving fan draws a current of air over the erasers, causing the chalk dust to be gathered up and wafted away through a pipe opening into a chimney or convenient ventilating flue. The machine is run by a motor. It not only cleans the erasers thoroughly, but keeps the felt in excellent condition. A machine, similar to the one shown, works by a handle and crank. It cleans one hundred erasers at a time.

When the chalk dust is shaken from the erasers, it is drawn off through a ventilating flue

© Brown & Dawson

Hooking eels through the ice. It is not as easy as it looks. Try it some winter's day and you will be convinced

You Don't Spear Eels in Winter—You Hook 'Em

SPEARING eels at night under the glare of a lantern or pot of fire fastened over the water to the bow of a boat, is an enjoyable summer and winter sport. In summer, eels are jabbed with a three-barbed spear. In winter they are taken with an eight-tined hook. It takes about ten times as much labor and patience to hook an eel through the ice as it does to jab one through the open water. Try it some cold winter's day and you will be convinced.

After the hole has been cut or dug through the ice, the eel hunters stand ready with their poles, waiting for their prey to come to the top. But the eels are not so anxious to come to the top as fish; consequently the hunters are obliged to reach down into the water and to hook any curious victim that may unwarily wriggle along to its fate.

As a rule, the poles are held stationary until an eel swims a few inches above the hooks. When the hunter has gaged the distance correctly, he gives a quick upward movement to his pole and the eel is impaled and held fast. During the winter nights, strange to say, eels remain at the bottom of an ice-covered stream.

The Single-Track Hanging Railway

It saves money in building and it uses the middle of the street

THE airplane and the submarine were born years ago. In their early youth they were unable to prove how powerful they would be in later years, and most people scorned their promise for the future. Inverted railways, so called, because the cars hang from the rails, must fight the same battle for recognition. There are still many people who ridicule this type of railway, even though a successful one has long been in operation between the three German manufacturing towns, Vohwinkel, Elberfeld, and Barmen.

The inverted railway. Central columns filled with concrete, support the entire structure

A railway somewhat similar to the German one has been proposed by J. B. Strauss of Detroit. This inverted railway has been suggested for use in our large crowded cities where traffic conditions are bad. Of the many advantages claimed for this system, the most important are the reduction of space occupied, of noise and of danger.

A general idea of the Strauss system is presented in the illustration. Here it will be seen that a central column supports the entire structure. Traffic conditions on the street below would surely be better with this single type of column than they are now with the two column system for, with our "keep to the right" regulations, the center of the street is not much used.

Many ways are suggested by which the customary noise of an approaching train on an elevated railway may be eliminated. Since the driving mechanism is above the train, it can be easily enclosed. The way in which the car is supported makes the use of ordinary ties unnecessary. The supporting posts are filled with concrete.

Since the desire for self-preservation is very strong within us, we naturally feel that the safety of such a railway is really the prime factor. In regard to this, we may be sure that derailment is impossible. As the rail is enclosed, snow and sleet cannot affect it. The system is so constructed that the car cannot fall. Shoes at the sides and bottom of the car ride on a guide rail in order to prevent the car from swaying.

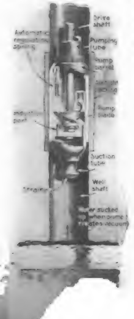
The system is constructed so that derailment is impossible. Guideways prevent the car from swaying

In comparing this proposed system with the successful one in Germany, we find only two noticeable differences: one is that springs instead of a guide rail prevent the car from swaying; the other is that the support which holds the car is of the double column type in the German railway. A very general idea of this is here shown. One is the type of support used over water, and the other the type used on land. Since these differences are unimportant, the Strauss system may meet with success.

Making the Desert Bloom like a Flower-Garden

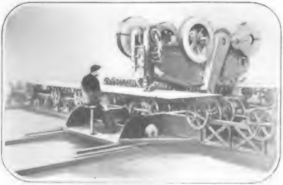
SAMUEL LIPPERT, veteran inventor of Cleveland, Ohio, writes us that he has developed a pump which he thinks some day will perform no less a feat than to make the Sahara desert a flower garden! Pumping water, he reminds us, has been a serious question ever since Biblical days when Jacob's well was drilled.

Lippert proposes to use "the free energy of the air." Not any other free energy, however, than that of the wind. Even the sporadic winds of the Greatest Desert can operate his pump, since it is rotary and is self-checking. A vertical shaft, leading from the mill vanes down to within a score of feet of the deeply-buried stream, rotates a set of screws fitting tightly against the inside of the pump casing. A corkscrew action is produced, and the water is sucked up the first twenty feet of the distance. All the rest of the journey, the water is simply screwed up.



The rotary pump for tapping deep underground streams. It is driven by a windmill

The inventor holding a small model of his rotary pump



One man working at this machine can punch over four thousand holes in heavy plate during a nine hour day

Punching Holes in Steel Plates—A Machine Used by Shipbuilders

PUNCHING more than four thousand holes in heavy plates during a nine hour working day is a modern accomplishment. It could not have been done so recently as a year or two ago. Plates for building ships must have many holes so that they can be riveted together into a finished vessel. The great expansion in steel shipbuilding industries has made the rapid handling of plates at punching machines a real necessity. The plate punch roller shown in the illustration has made this rapid handling possible, and it is in use in many of the new plate shops.

The plate is laid on the table and the operator, from his seat, moves the table backward and forward with the aid of an operating lever at his right hand. At his left hand is another lever, which can be operated to move the plate sideways, thereby placing it in the desired position for punching. The punch is controlled by a foot lever.

Plates from one-quarter to one-eighth of an inch thick, and up to thirty by eight feet in size are handled. The tables are built with roller bearings.

Another Use for Tree Roots. Make a Fence of Them

WHAT shall be done with tree roots after they have been dug or dynamited from the soil to prepare it for the plow? The answer is given by a farmer who lives in a western state where the barbed-wire fence is in general use. Gathering several hundred tree roots, he transported them to his farm and there arranged them to take the place of the usual wire fence.

© Brown & Dawson

Roots of trees arranged to serve as a fence. They answer most of the purposes of barbed wire

There are hundreds of miles of fences in the far West which serve merely to indicate the dividing lines between adjacent ranches. Discarded tree roots answer the purpose as well as wire. As a rule they are never used for fire wood, principally because they are hard to saw into stove lengths. Furthermore, they require a long time to dry.

When arranged in a straight line to serve as a fence, the trunk ends of the roots are placed facing the direction of the strongest prevailing winds. In this position the roots rest most securely on the ground and the prongs act as efficient anchors.

Cost of Placing Roadway Stone Reduced by Simple Spreader

IT'S expensive to distribute crushed stone for road construction work. That's why the simple box-spreader shown in the photograph was invented.

The spreader is attached to any type of wagon or motor truck. The rear gate or opening is set to spread the stone uniformly over any desired width, obviating the necessity of hauling stone from one point to another, either to trim off the high spots or to fill in the depressions. The spreader consists of a box with slanting sides and a rear gate set to any desired opening. The box is attached to the rear end of a wagon or truck, as shown below.

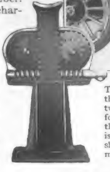
By varying the speed of the vehicle and the size of the opening in the gate, any desired depth of stone is spread automatically without any hand labor.

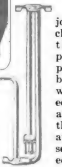
Where the roadway is so narrow that the stone can be spread while the vehicle is running in one direction only, a V-shaped spreader-board may be employed, as shown, to distribute the stone evenly over the entire width of the roadway. When a second and narrower layer of fine stone is wanted on a road already covered with a coarse layer, the V-shaped spreader-board is used. It not only does the work better than it could be done by laborers but it saves much time and expense.

In circle: How the stone is spread uniformly. Above: The spreader used in connection with a motor truck

A Boy Can Lift a Two-ton Car with This Worm-driven Jack

THE automobile jack, shown in the accompanying illustration, was originally developed for lifting freight car trucks for the replacement of bearings. It is the first of its type to employ a worm driving member. The jack is characterized by two main features, the greater and more uniform power application secured through the use of the worm gears instead of ordinary toothed pinions, and a collapsible, universal-ended handle by means of which it may be placed under the car axle so that the car may be lifted without making the operator get out and get under. This is in part made possible by the great power secured through the worm gear and worm wheel reduction.





The collapsible handle is three feet long and has two joints so that it can be folded up and placed in the tool-box. The handle is attached to the worm shaft of the jack by means of a universal joint

The jack has no springs, pawls or ratchets and is operated through only four working parts, a central rack, a set of two worm wheels, two worm gears on the same shaft to drive the wheels and two smaller pinions, placed one on the back of each wheel. Since the worm gears are integral on the same shaft, power is applied evenly to each side of the central rack, giving an easy and uniform lifting motion.

The Dogs Were Hungry and So They Ate the Church

IN the Hudson Bay country, where the dogs are half wolves, a band of these famished animals actually ate up a church. The Eskimo Christians had built a tiny chapel, to hold twenty people. But the poor converts did not long enjoy the little church, of which they were so pathetically proud. The building was of whalebone, an edible substance, and one Sunday, the pagan dogs ate every morsel of the sacred edifice.

The Bag Within the Garbage Can. It's Sanitary and Sensible

A stout paper bag fits into the street refuse container

A STREET garbage can need no longer be emptied by being lifted bodily, while its unsavory contents are thrown into the uncovered cart.

William M. Walsh, of Grand Rapids, Michigan, has invented a heavy paper bag which fits snugly inside the ordinary metal container. The bag is fitted with a draw string at the top, and after it has been filled, it is closed and removed. No unpleasant odors escape as the bag is being thrown into the wagon. Moreover, the can remains stationary and its surface escapes the unsightly dents and scars which result from too gymnastic handling.

You Can't Fool the Law of Gravity, But the Motion Picture Can

THE photographs shown below illustrate one of the cleverest devices ever invented by the modern magicians of the movies. The upper picture is what we see in the studio—a wall and telegraph pole set up at an angle of forty-five degrees. Suppose that the actor wishes to climb the pole and enter one of the windows. Or suppose he wants to slide from the third story window to the ground. Quite simple, is it not? And it would look just as simple and uninteresting on the screen if the motion picture camera were placed as we should naturally expect it to be placed. But it isn't. That is just where we are deceived. The camera is placed at the foot of the incline and pointed upward along the slope of the wall at a corresponding angle.

Above: A motion picture climb as it looks in the studio. Below: The identifical climb as it appears on the screen

On the screen we see a perfectly vertical building, with actors climbing straight up from one window to the next, crossing over from telegraph poles and performing the most difficult acrobatic feats. Yet the scene is so convincing that we credit the actors with superhuman powers in spite of manifest impossibilities. In order to get the full effect of this illusion, turn the upper photograph around until the pole is vertical. So long as the law of gravity carries no jail sentence for its violation the picture people don't mind tampering with it photographically.

One Inner Tube More Than Holds Up an Automobile

HOW strong is a rubber tube used in an automobile tire? How far can it be stretched? How much weight can it lift? These were the questions that vexed some tire manufacturers and they straightway set about to find an answer to them. To the layman it would seem as if the ordinary inner tube couldn't be stretched more than from three to four feet, and, judging by the frequency with which tubes burst when they are inflated by careless persons, one might easily believe that they are extremely fragile. Such, however, is not the case.

The test which was adopted to prove the resisting qualities of a tube, was a novel and interesting one, as the accompanying illustration shows. An automobile, weighing two thousand four hundred and sixty pounds was encased in a frame, bringing the total weight up to two thousand nine hundred and ninety pounds, and the whole was lifted from the ground by means of a block and tackle so arranged that the entire weight was borne by the tube, which made up the section immediately above the framework. The tube stretched under the combined weight of the automobile and frame until it reached an uncanny length, but it did not break or split. After the test, it resumed its normal shape and under critical examination appeared to be in perfect condition.

The automobile suspended in mid-air by an inner tube

Little Winston-Salem Is Our Biggest Tobacco Center

ALTHOUGH two hundred miles from the seaboard in North Carolina, Winston-Salem, a dual city of seventeen thousand inhabitants, has been designated as a port of entry by the customs officials, because its imports of sugar, licorice and tobacco are enormous. Since 1910 the manufacture of tobacco products has increased more than three hundred and seventy per cent. Indeed, it is believed that Winston-Salem now leads St. Louis as the chief tobacco manufacturing city in the United States. Eight days after the Government had given Winston-Salem a $250,000 post-office building, the city had paid for it in tobacco revenues.

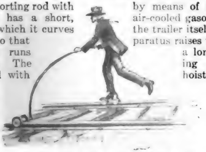
Skating Along a Railroad Track

HOW would you like to skate along a railroad track? You can do it now, thanks to an invention of Dwight B. McNamee, of Heman, Oklahoma.

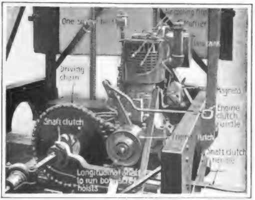
Mr. McNamee has devised a skate for use along trackways. The four wheels of the skate are provided with hubs which engage with the top of a rail, and with rounded flanges which hold the wheels to the track.

You must use a supporting rod with this skate. The rod has a short, straight handle, from which it curves forward and sideways so that the roller at its end runs along the opposite rail. The roller also is provided with flanges.

Keep the balancing rod ahead of you and you will not be in any danger of falling forward as you propel yourself along with your free foot.



The skate runs along the railroad track. The balancing rod is held ahead of the skater



The longitudinal shaft drives two vertical screw-hoists, one at each end

The body is here shown in its elevated position. It has small side chutes

This Trailer Elevates Its Own Body

DIFFERING from previous forms of elevating trailer bodies, raised and lowered by means of hydraulic, pneumatic or mechanical means operated from the power of the pulling vehicle, the arrangement shown in the accompanying views does not require the truck to stand idle during the loading and unloading periods. Instead, its body can be elevated seven feet in less than one minute by means of a small one-cylinder, air-cooled gasoline engine carried on the trailer itself. This elevating apparatus raises the body by means of a longitudinal shaft driving two vertical screw hoists, one at each end.

The body is designed for carrying coal, earth, sand, gravel or other bulk material. Quick unloading results in maximum efficiency.

Softening Water by Filtering It

For domestic use a water softener is an absolute necessity to prevent waste

THE production of absolutely soft water (water of zero hardness) is one of the most notable recent achievements of industrial chemistry. A little more than half a century ago two English chemists, Clark and Porter, discovered that the addition of lime and carbonate of soda would reduce the hardness of natural waters. To soften water completely, however, was considered an impossibility, save by distillation. Then came Dr. Robert Gans, a chemist in the service of the German Geological Survey, with the discovery that certain substances in the soil, known as zeolites, had the power of absorbing hardness from water brought in contact with them. Since the capacity of natural zeolites to effect this change was found to be too weak for commercial use, Dr. Gans set about the production of an artificial zeolite which he called Permutit. His artificial product softens the hardest of natural waters. Furthermore it is entirely insoluble and can be used over and over again.

Permutit is essentially a silicate of sodium and aluminum and when hard water, that is, water containing in solution salts of calcium and magnesium, is passed through a filtering medium of this substance, the sodium in the permutit changes place with the calcium and magnesium, which remain in the filter, thus substituting sodium salts for them and softening the hardest natural water.

Permutit is of a granular and flaky texture, very porous, exceedingly tough and possessing a mother-of-pearl lustre. It is made by fusing in definite proportions the minerals, feldspar, kaolin, pearlash and soda. The fused mass is crushed. After the soluble matter is washed out the mass is ready for use.

Permutit can be regenerated when all of its sodium has been exchanged for calcium magnesium. This is accomplished by allowing a solution of ordinary table salt to stand in the filter over night. The calcium and magnesium in the filter are replaced automatically with sodium, and the filter, after a washing of about thirty minutes, is again ready for use. There are filters which have been regenerated nearly three thousand times.

Above: How the water is softened simply by passing it through a filter filled with permutit

At right: A filter which supplies thousands of gallons of soft water a day for industrial purposes

Armless—But Able to Paint Pictures and Signs for All That

IN the little town of Chailey, in England, is a picturesque institution for cripples, known as the Heritage School of Arts and Crafts. Here for many years crippled boys and girls have had a chance to gain health and strength in the open air so that ultimately they could earn their own livelihood.

During the last two years, the school has extended its usefulness by taking in soldiers and sailors disabled in the present war, and re-educating them side by side with the crippled boys. The example of the lads has proven a great inspiration to men handicapped, according to their own conception, beyond hope of ever again being useful.

In one of the accompanying pictures is shown an armless, crippled youth at the Heritage School of Arts and Crafts, painting a tombstone for a favorite pet, buried in the Institution's animal cemetery. The boy holds the brush between his toes which have become almost as agile as fingers and is able to do very creditable work. The second picture shows this same youth teaching an armless child to paint with his feet.

He holds the brush between his toes and is able to produce very creditable signs and pictures

At right: The armless master teaches an armless youngster how to paint with the feet

The monorail car is held on the rail by the ore which it carries in bins on either side

Shipping Ore by Monorail Over a Two-Mile Gap

WITH a gasoline engine furnishing the motive power, a monorail locomotive has been constructed in the Cœur d'Alene mining district of Idaho, to transport ore concentrates to the railroad. It is handling ore at twelve and one-half cents a ton per mile, whereas the old system cost four dollars a ton.

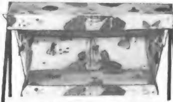
The car, with two double-flanged wheels, runs on a thirty-pound rail, spiked to the top of a heavy beam, while guide wheels on either side help to maintain the equilibrium. The bins hang low on the sides and each one holds a ton and a half of ore. One man constitutes the train crew. The bins are loaded from chutes and are dumped by levers. According to the inventor, H. W. Shepherd of Seattle, Washington, a car similar to that shown, equipped with a converted Ford engine, can be built for $600. The track costs about $2,500 a mile.

Housekeeping Made Easy

A fancy stand which can be adjusted to hold any length skein of yarn for winding into balls

A shaving mirror with hanger to be attached to an electric light

Imitation tulip placed in a pot. The flower is a twine holder



Child's swing built like one for adults. The figures on the cloth are designed to please children

A convenient household lighter which can be used like a match for safely starting a fire

A chiffonier built for baby's little clothes. The top of the chiffonier is used for a dressing stand

A coffee pot and a percolator combined, in which the coffee may easily be stirred while it is brewing

The palette knife makes an excellent kitchen utensil for removing cookies and cakes from hot baking pans

Housekeeping Made Easy

A high chair seat arrangement that can be taken with baby and used in a restaurant or in an automobile

This closet is not for storing pots or pans, but for easy access to the kitchen plumbing

A doctor's folding medicine spoon, and case

The bottle of this ornamental library drinking set is concealed in the figure

A tall lamp for the seamstress, the standard having a tray for holding buttons, hooks and eyes and other conveniences

Cigarette holder and ash tray. The receptacle holds cigarettes which are delivered one by one

Antiseptic vapor in lower chamber sterilizes the tooth brushes in these individual glass containers

This mattress is made up of eight sections which are connected on one side. It is easy to carry about

The Giant Periscope. It Peeps Over Tree Tops Like a Giraffe

THE old French saying, "Be silent; your enemies are listening!" might well be paraphrased by the Germans to read, "Lie low; the English are looking!" Like the person "from Missouri," the British officer must see his way very clearly. For this reason, perhaps, the periscope is put to more strenuous service among the English troops than among any of the other belligerents.

The accompanying illustrations show a pole periscope of a late design, which is extensively used by the English and also by the Italians, because it enables an officer to peep over tall obstacles, whether mountain peaks or merely tree tops. The height to which it can be run up depends upon the number of sections of which it is made. The sections telescope into the bottom tube when not in use and during transportation, for which a tiny two-wheeled truck is used. The truck is often run up under the protection of a tree, and spikes are nailed in the ground to hold the apparatus close against the tree-trunk. It is the work of but a moment to turn the crank and send the telescoped sections up into the air until the top peeps out over the tree top. In one village on the Somme, a periscope of this kind, set up in a little protected cove, kept the Allied armies informed of every movement of the Germans, who were behind massive entrenchments at that particular spot. The body of the truck is built so low that it can be easily concealed by brush.

The pole periscope in position. It may be folded up in a truck

An Ambulance with Its Own Traveling Kitchen

EACH of the new motorized units of the United States Army Ambulance Corps has its traveling kitchen. These units have taken over the front-line trench work formerly performed by the Red Cross.

The vehicles of each unit consist of twenty Ford ambulances and of two one and one-half-ton trucks to carry baggage and supplies. One of these trucks hauls behind it the traveling kitchen which is mounted on a light four-wheeled trailer on which is carried a field range with all the necessary stew kettles, roast pans and the like to serve three meals a day to the forty-five men comprising a section. The traveling kitchen makes each unit independent of its base for cooked meals, provided its supply of food does not run out. This is an advantage of the greatest importance from the quartermaster's point of view.

An American ambulance with its own traveling kitchen which is mounted on a very light four-wheeled trailer

Killing the Boll-Weevil with a Deadly Gas

EVERY bale of cotton that comes into the United States must first be disinfected before it can be placed on the market. This is necessary because of the boll-weevil and other pests.

The cotton is placed in a steel chamber from which the air is extracted. Hydrocyanic gas fumes, one of the most deadly poisons known, are then introduced. The gas permeates every part of the bale and all living things are immediately killed. The boll-weevil is an undesirable immigrant.

© Underwood and Underwood

The cotton bale is placed in an air-tight steel chamber filled with hydrocyanic gas fumes, which kill all insects

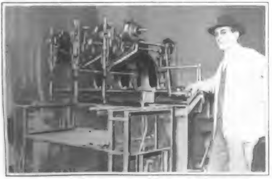
Driving Eight Hundred and Fifty Rivets a Minute in a Trunk

FROM the time he was seventeen years old Thomas Cumming of Grand Rapids was an influential business man, devoting every spare moment to the construction of a machine which would do away with much of the hand labor required in making trunks. Now he steps before the world with the invention here pictured.

The machine is about as high as a man. It occupies a floor space measuring approximately six by six feet. A child can run it and yet it is an intricate piece of mechanism.

An automatic carriage holds the trunk firmly while it moves through the machine. An entire side is completed at one time. The rivets are driven in a straight line, something almost unheard of in trunk-making.

With the old one-man-power machine used in factories, the operator must hold the trunk and drive the rivets at the same time. If he is an expert, he may drive them in line. His speed is from eight to ten per minute. Cumming's invention drives one hundred and eight per minute with each driver, four hundred and thirty-two for the machine.



After twenty-five years of work Thomas Cumming invents the first machine for riveting trunks at high speed

When handled by an expert it drives a total of more than eight hundred and fifty each minute. Think of it! It does the work of forty to one hundred men. The operator simply places the trunk in position and controls the machine. More drivers can be added if necessary; each increases the speed of the machine by driving one hundred and eight to two hundred and twenty-five rivets per minute.

A Lovely View of this Thermometer May Be Had Through a Periscope

SUB-STATION operators are like waterworks engineers—generally with plenty of time on their hands and always devising short-cuts and ingenious devices of one kind and another about their respective domains to do their work with more dispatch. These improvements are of great value in emergencies, not to mention everyday routine.

Here we have an indoor periscope devised by employees at a Walla Walla, Wash., sub-station. It is for the purpose of reading a thermometer high up on the side of a transformer. The line of sight goes from the thermometer to a mirror tilted toward it at the upper end of a metal tube, then down the tube to another mirror which faces the operator. Now the operator need not hustle around to find a stool or a stepladder whenever the thermometer needs reading. It may be said in passing, that thermometers are put on transformers in order that an eye may be kept on the temperature of the insulating oil inside.

A periscope for reading a thermometer high up on the side of a transformer

Feeding Cattle from Railway Cars to Fatten Them

THE desert cattle ranchers of Arizona and New Mexico have learned that to raise cattle is one business, and to fatten them is another. For this reason, they ship their cattle to California, where sugar beet pulp is obtained in abundance. One factory is located near the fields where the beets are grown. The cattle are turned into this field after the beets are harvested.

Under the fence is placed a trough which projects outside of the fence just enough to allow the beet pulp to be thrown into the cars. The cars run on tracks from the factory to the field and follow the fences around the corral. More space is thus obtained for the beef cattle to feed, and there is but little waste of fodder. In these war days the cattlemen are learning to conserve stock food, as the cattle themselves are conserved for our use.

If Coal Is Too Expensive, Burn Sawdust, as They Do in France

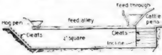
IN some portions of France where coal is so scarce and consequently so expensive that it is altogether unobtainable by the poorer class of people, sawdust is being used as a substitute. The sawdust is rammed down tightly in cylindrical metal boxes, and a few drops of petroleum are poured over it. The fire thus made can be used for cooking and all domestic purposes, and will burn for several hours.

Cars which run from the factory to the fields throw the beet pulp into the troughs which run along the fence

We Fish for the Clam with Dynamite

A CLAM cannot come out of its shell. Its home is on the low sandstone ledges, into which it bores by means of its sharp shell, to a depth of six or eight inches.

The little pholas or boring clam is a great delicacy on the Pacific coast. Its meat is juicy and tender and is excellent in chowder. Consequently, fishermen are not content to dislodge the clams slowly with pick and crowbar. They use dynamite, one blast of which dislodges hundreds of clams.



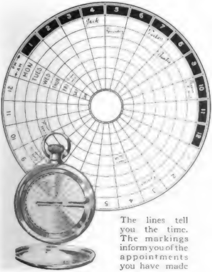
In order not to block the feed alley, the pigs have to go through a subway to reach their own eating troughs

For a Perfect Private Secretary, There's Your Watch

IF you have a thousand things to remember this coming week, let your watch be your secretary. Not your ordinary watch, however, but the one designed by W. F. Tubesing, of Milwaukee, Wisconsin.

A dial, rotating once in twenty-four hours, takes the place of the hour and the minute hands. Seven concentric rings marked upon the dial correspond with the seven days of the week. The radial lines on this dial divide off the hours of the day.

On Monday, a stationary pointer on the watch is extended until it lies over the outermost circle. Early on that morning, you mark within the time lines, the corresponding engagements for the day. Then just glance at your watch and you will be reminded of each appointment in due time.

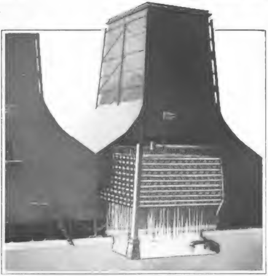


The lines tell you the time. The markings inform you of the appointments you have made

The Pig Subway and Why It Was Invented

THE feeding barn of a Pennsylvania farmer is used to feed cattle on one side and hogs on the other. In going from the "cattle side" of the house, to their own, the hogs had to pass through the alley in which the farm hands served the feed into the different troughs. The hogs would stop in this alley and try to reach the large piles of corn in the bins before continuing on to their pens. Many difficulties would result.

To do away with this loss of time and energy, the pig subway was invented. A small tunnel, about two feet square, was dug under the alley. Now the hogs must go through that. Needless to mention, the pigs didn't take long to adapt themselves to the passage when their "eats" were on the other end.

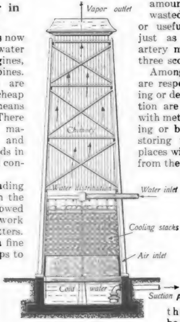


Cold spray dropping down to the cold water sump or reservoir at the extreme bottom of the wooden tower

Cooling Engine Water in Wooden Chimneys

HUGE wooden chimneys now serve to cool the water from powerplant steam engines, especially from steam turbines. Usually fans or blowers are installed—but not in these cheap towers. Think what this means in keeping down cost. There are no moving parts of machinery to be inspected and overhauled at regular periods in order to keep them in good condition.

The water is cooled by leading it to a horizontal header in the center, from which it is allowed to drop upon a checkerwork of iron pipes and lateral gutters. Thus it is broken up into a fine spray which ultimately drops to the cold water reservoir at the extreme bottom of the tower. Here the hot water is further cooled by the passage of cold air entering on either side of the tower bottom and drawn up and out the top of the tower by natural draft, just as smoke is drawn out of the top of an ordinary brick chimney.



How the wooden chimney works. No expensive fans or blowers are needed

Prolonging the Life of a Motor by Protecting Its Insulation

BROADLY speaking, a motor may be divided into two parts—the windings, through which the current flows, and the part into which the current must not be allowed to leak. The windings, which may be called the circulation system of the motor, are analogous to the arteries of the human mechanism, and the insulation to the walls of the arteries. To continue the simile, if the insulation is cut or seriously impaired, there is danger of such an amount of current being wasted as to destroy the life or usefulness of the motor, just as the severing of an artery may cut short a man's three score years and ten.

Among the practices which are responsible for the weakening or destruction of the insulation are prying into windings with metal instruments, pounding or bumping the windings, storing the motors in damp places without protecting them from the dampness, which may proceed from a leak or from escaping steam, or placing them in an atmosphere laden with acid fumes or minute flying particles of metal.

Periodic attention to the insulation as well as to the other parts of the mechanism will be amply repaid. Accessible parts should frequently be wiped clean.

This Device Protects Your Check From the Forger

A CHECK book cover provided with a protecting device which makes it impossible for a man to raise a check, has been placed on the market. Various amounts up to one thousand dollars are stamped on the check near the row of perforations where it is detached from the stub. The protector is permanently attached to the leather cover of the check book, and it can be quickly adjusted for any of the three columns of figures. A sliding straight-edge is moved either up or down to the correct figure. The protector is pressed fast and the check torn from its stub.

Tear off your check, and the maximum amount appearing at the left is your protection

The Electric Stevedore Distributes the Mail

THE mail of the various departments of a big manufacturing plant in East Pittsburg is delivered by an electric truck, of the type commonly known as "the electric stevedore." On the flat body of the little truck is mounted a sorting table which has eighty pigeonholes, which occupy shelves on both sides of the vehicle. The mail is sorted while the car is running, and the saving of time is about fifty per cent over the former method.


A specially fitted truck takes the place of a pneumatic tube system for distributing mail

Mail is collected from the various departments by the same vehicle, and large packages, which formerly would have been delivered by a special messenger, are stored beneath the pigeon holes on the floor of the car.

A driver and a clerk go with each truck. Six complete trips a day are made. The extent of the plant can be estimated from the fact that each trip requires at least an hour, and sometimes an hour and a half, depending on the quantity of mail to be distributed, and the congestion of the aisles. The deliveries are all made under one roof although over two floors.

This system takes the place of pneumatic tubes, through which bulky pieces of mail could not be sent.

How Cutting Tools Are Doing Their Bit

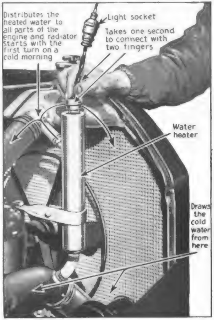
ANY manufacturer who is turning out tools is as important to the Government as if he were making munitions.

Nine hundred and ninety-seven cutting tools alone are required in manufacturing a modern rifle. The twist drill is one of the busiest of these. To supply a million rifles, ninety-four million holes must be drilled.

Shrapnel, torpedoes, machine guns, biplanes, motor trucks and anti-aircraft guns require from seventy to five thousand holes each.

Keeping the Radiator Water Warm During Freezing Weather

A NEW electric arrangement for preventing the water in automobile radiators from freezing, has been invented by Philip Apfel. An electric-heating element is attached to the radiator bypass under the hood. The insertion of a plug connected with any lamp socket, insures the supply of current. A thermostat in the circuit turns on the current when the temperature falls below the freezing point. Should the heating plant of the garage go out during the night, your radiator water would be warm in the morning. In fact, you could adjust the thermostat to keep the water at sixty degrees, so as always to be able to start the engine at once.



The electric heater warms up the radiator whereupon the water begins to circulate

Ventilating a Huge Building Covering Forty Acres

MANUFACTURERS are realizing, as never before, that light and air have a profound physical influence on the working man. Accordingly, old factory buildings, generally poorly ventilated, and practically windowless, are being supplanted by the modern building with glass top and sides. The accompanying illustration gives a vivid idea of the new light and air principle of construction.

Covering forty acres, this giant building is as perfectly ventilated and lighted as if it had no walls or roof. The central portion of the roof is inverted like two great wings, whose slope deflects heated air to the outlets. The air comes in through low intakes and goes out through raised outlets in a way that causes natural changes. Chilling downdrafts are prevented by the truss roofs which force the ascending currents strongly toward the outlets. Forced ventilation is not resorted to unless a building is so huge that the ordinary methods of natural ventilations can not be successfully applied.

In the new system, light is abundantly and evenly diffused. There are no dark corners anywhere about the premises. The under sides of the inverted roof are painted white, thereby utilizing by reflection, light which is lost with the ordinary roof design. This system was first designed for foundries and forge shops. The escape of heat is hastened by locating the cupolas, molds, furnaces and rolls under the outlets, so that heated air and gases go straight out.


Two frames in the center admit light and air, and two others admit light and discharge [illegible]
This arrangement prevents any chilling down-drafts and insures a natural change [illegible]

"Transfer, Please," Is Answered by An Automatic Machine

An inventor has taken out patents on an automatic transfer issuing machine that can deliver transfers at the rate of sixty per minute.

On top of his machine are a number of individual buttons which represent either intersecting car lines or other transfer points. By pressing one of these buttons and operating a foot lever, the proper transfer is delivered. It is punched with the month, day, hour and line to which it is issued.

The transfers are supplied in small rolls of five hundred or a thousand. As each transfer is issued, it is recorded by the machine, so that the auditing department always has an accurate check on the conductor.

This machine issues transfers at the rate of sixty a minute and records the number issued

Use Your Ladder Properly and Avoid an Accident

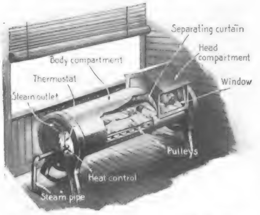
Like all other accidents, those caused by ladders are divided into two classes: those due to unsafe equipment and those caused by unsafe practices. Look at the accompanying photographs and you will see some very common causes of ladder accidents. How often have you misused your ladder in one of these ways?

There are means by which you can safeguard the base of your portable ladder. Metal points, lead-coated plates and carborundum have been found to serve very well. The state of Pennsylvania goes so far as to make it a legal obligation to have a man at the foot of each ladder when the floor is of iron. Pivoted lead shoes are recommended for concrete floors and rubber bases for wet floors.

Have you misused your stepladder in one of these ways? To use a half opened ladder, a ladder elevated on bricks or one placed on a movable platform, is to court sure disaster

Can Yourself for the Night and Turn On the Heat

GOING to bed will soon be the most difficult and dreaded of the day's tasks if the inventors are allowed to have their way. One of them, James E. Hanger, of Washington, D. C., has evidently forgotten all about the adage that a hard day's work will put feathers in any old bed. He has devised a queer contraption which for exterior appearances at least appears to be a cross between a houseboat and a silo.



To sleep comfortably, emulate the ground hog and crawl into your can-bed. Dormer windows admit air

Imagine yourself lying in his bed, with your head under the house-like structure at one end and your feet under the ventilator at the other end. You are in the same position as a piece of canned asparagus. There is, however, at least a slight difference. Your head is literally cut off from the rest of your body by a cloth partition which prevents the air from reaching that part of the body below the shoulders. Dormer windows enable the sleeper to obtain as much air as he wishes through the house structure, but from the shoulders down, artificial heat is admitted into the can through a pipe joined to the foot.

The semi-cylindrical part of the bed can be moved back and forth as the occupant wishes. Instead of the ordinary mattress, cords are stretched between pulleys made fast to the sides, so that the bed may sag as much as one wishes. The inventor says his device is particularly fitted for invalids.

Lifting a Rowboat Out of the Water by a Twist of a Lever

ORDINARILY, to raise a boat out of the water and place it upon a float, two men lift one end and drag the boat about half its length over the edge of the pier. Then, with the float serving as a fulcrum and the boat as a lever, the other end is raised and dragged up.

The one-man boat-raising device which Harry Houghton of Seville, Ohio, invented, consists of a lever-acting frame, a portion of which extends below the water line and under the boat. By means of a lever, fulcrumed to the frame, the boat is tilted up so that the water in it is dumped out as the boat is raised.

The operation of the lever is plainly shown in the accompanying photograph, in which a small boy is seen doing what formerly required the services of two men. The wear and tear on the boat have been eliminated.

By means of this lever-acting frame, even a small boy can haul a heavy rowboat out of the water

Setting President Wilson's Portrait in Type

HARVEY PARSONS is a cartoonist on the staff of a Topeka newspaper. He conceived the original idea of setting up President's Wilson's reply to the Pope in type, in such a way that the result would be not only a readable reproduction of the message itself, but a portrait of President Wilson.

First of all, Parsons drew a likeness of the President. With that before him, he gave minute instructions to O. W. Kelly, an old printer friend of his. Parsons does not know Nonpareil from upper case Roman; yet he was able to make Kelly understand what was wanted. After his successful experiment, the artist declared that he could write instructions to a printer which would read: "Set a yard of the old Testament in 8-point Gothic as per . . ." with a string of symbols and figures. And what would be the result? A type portrait of Moses! And the printer would not know it until he had pulled his proof.

As our illustration shows, light-faced type composes the high lights of the picture, and black or bold-faced, the half-tones and darker portions. The proper spacing of the letters is not destroyed, and the reply to the Pope is legible in spite of the underlying likeness. The portraits are set in type by machine.

Hold the illustration at arm's length and the effect will become much more apparent

A railway car which looks like an automobile and is controlled like one, but which runs on an ordinary track

What is It—Jitney or Railway Coach?

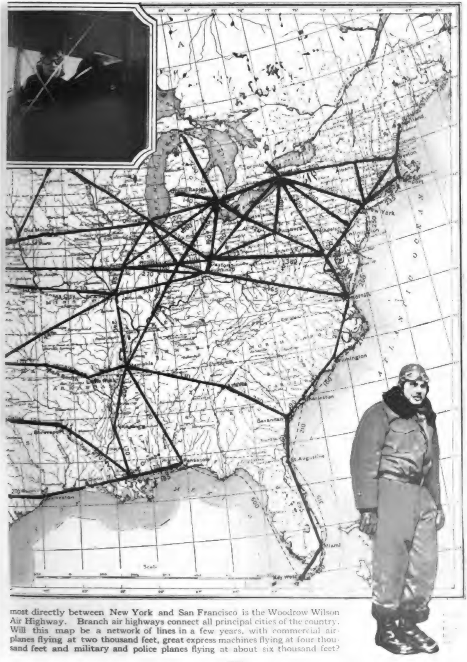
A MOTOR truck body, a set of flanged wheels and a light automobile engine constitute the rolling stock of a Louisiana railway. The road connects Christie and Pearson and carries on a lively business. The "super-jitney," as it has been designated, operates on a regular time schedule and is able to make excellent speed despite its rather cumbersome appearance. It can conveniently accommodate twenty passengers, and in addition can haul a great deal of express and merchandise, by stowing it under the seats or on the top of the coach. No matter how heavy the load, there is practically no vibration, for the railroad bed is still in good condition.

Because Transportation Is Civilization the World

Redrawn from a chart prepared by the Curtiss Aeroplane Corporation

Kipling's dream that the year 2000 would see the earth and the air above it planned and plotte for aeronautical traffic has already been realized. Here we are thinking of the air as the world' medium of transportation for mail service, passenger and freight traffic! **Men are mapping ou aerial highways in France, Germany, England, Italy and the United States, preparing for th day when air travel will take precedence of nearly all other human activities. Running**

Preparing Itself for Commercial Domination of the Air



most directly between New York and San Francisco is the Woodrow Wilson Air Highway. Branch air highways connect all principal cities of the country. Will this map be a network of lines in a few years, with commercial airplanes flying at two thousand feet, great express machines flying at four thousand feet and military and police planes flying at about six thousand feet?

A Track-Laying Tractor

Its front wheel lays a track and the whole machine turns in a ten-foot circle

Above: Plowing a field with the aid of the track-laying tractor

At right: The tractor can easily make a turn in a ten-foot circle

Above: The shoes are made of steel stampings. They can be provided with projections for very soft ground

OUT in California, where the small, farm tractor has been more highly developed than in any other part of the world, an unusual tractor has appeared. It has three wheels like many other tractors. But in this case, to give great pulling power, the front or steering wheel is a track-laying wheel. Still, the unusual characteristic of the tractor is not so much the small track-laying unit used as a front wheel, but the manner in which the frame supporting the unit is employed to carry the small automobile internal-combustion engine and its fuel and water tanks. An inverted, U-shaped casting, attached to the rear of the frame, permits the whole frame, track-layer and engine, to turn as a unit when the tractor rounds a corner.

The top of the U-shaped casting serves as a turning pivot for a goose-neck frame, to which is attached the two rear steel wheels, and the axle to which the plows or harrows employed are attached.

The tractor is further characterized by burning the cheap engine distillate so commonly used in California in place of expensive gasoline.

In the accompanying illustrations, it can be clearly seen that the engine is mounted as in any automobile, longitudinally of the frame, but that it drives the track-laying wheels by means of a two-part, cone-shaped friction gear mounted on the rear end of the extended engine-shaft. The shoes or face of the endless track, somewhat similar to those used on the famous British "tanks," although much smaller, are made of steel stampings. They can be left flat for running over firm roads or they can be provided with angle-iron grousers or projections to grip very soft ground.

The tractor may be used for any kind of farm cultivation. It has a speed of about two miles an hour when pulling a four gang plow. The machine weighs less than three thousand pounds, has an overall length of one hundred and two inches and can turn completely around in a ten-foot circle. Its small size is one of its greatest assets.

Why the Horse Is An Aristocrat

He is the product of an ancestry that goes back three million years

THE earliest known ancestor of the horse, called the Eohippus or "Dawn Horse," is believed to have existed more than three million years ago, in what is known as the Eocene Age, hundreds of thousands of years before the coming of man. Fossil remains of that animal were found in certain rock strata in this country. From the remains of a skeleton uncovered in New Mexico; J. W. Gidley, one of the scientists connected with the United States National Museum, in Washington, D. C., reconstructed the interesting model which is pictured here.

Above appears the highest type of horse, the result of many centuries of careful breeding and selection. At his feet is shown his earliest ancestor, the Eohippus, who stood little more than fourteen inches high at the shoulder

This earliest known ancestor of the horse was about the size of a small fox, standing a little more than fourteen inches high at the shoulder. He had four toes on each of his front feet and three-toed hind feet. His teeth were small and short-crowned. He probably lived around the margins of lakes, where the ground was more or less soggy, and pastured on grass.

In the course of thousands of centuries, his physique developed as his needs required. His size increased and his skeleton underwent important changes in accordance with his altered living conditions and habits.

The horse of the Oligocene period, known as Mesohippus, was about the size of a sheep and had three toes on each foot. In the Miocene, a little later period, there were numerous large horses, all with three toes on each foot, but with the middle toe much larger than its companions. Their teeth were much longer, more powerful and much deeper-crowned.

In a still later period, called the Pliocene, were found the first horses with but a single toe on each foot, which soon developed into a hoof. The auxiliary toes, being useless, disappeared, and only the stumps remained, traces of which may be seen in modern horses, even those of the highest stock.

True horses, of the form and approximate size of the modern steed, were not found until the Pleistocene period. These were common all over North America and Europe. Although they resembled the modern horse, they were smaller in size, and inferior in strength and fleetness.

Those of us interested in science, engineering, invention, form a kind of guild. We should help one another. The editor of The POPULAR SCIENCE MONTHLY is willing to answer questions.

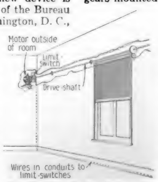
Drawing Twenty Shades at Once

The stereopticon operator pushes a button and presto! the shades are raised or lowered

A simple push of a button by the stereopticon operator and all the shades in the auditorium are lowered simultaneously. Another push and they are raised

THE inconvenience of having to draw each window shade separately in an assembly room when motion pictures or stereopticon views are to be shown, has been overcome by an electrical device, which makes it possible to draw all the shades simultaneously by simply pushing a button. This new device is installed in the auditorium of the Bureau of Standards building, Washington, D. C., and is manipulated by the motion picture or stereopticon operator.

Two horizontal shafts extend on each side the full length of the room within the wall, directly over the window frames. Each shaft is revolved by means of a small electric motor, placed in a pocket in the wall just outside of the auditorium, as shown in the accompanying illustration. A special switch is installed near the motion-picture projector, by means of which the operator can easily turn the shaft in either direction, so as to raise or lower the shades.



Details of the limit switch which opens and closes the circuits

Power is transferred from the motor shafts to the shades by means of gears on the shafts, which mesh with smaller gears mounted on one end of each roller.

A limit switch controlled by the operator's main switch, breaks the circuit when the curtain has been pushed down to its lowest or up to its topmost position. The direction of revolution of the motor shaft is controlled by the operator's switch, and the gear on the motor shaft drives that on the end of the roller, as shown. The revolution of the motor shaft causes the threaded nut around the motor

shaft at the center of the switch to move in either direction and to break the current circuit by contacting with one or the other of the two bell-crank levers. The two movable rubber blocks on which the bell-crank levers are mounted, are adjusted by screws, working in the slots shown, so that the contact on the right opens when the curtains have reached their upper limiting positions, and that on the left when they have reached their lower limiting positions.

The system has a number of defects, due mainly to the fact that it was not installed until after the walls of the lecture room had been started. This made it necessary to operate the curtains entirely from the tops of the windows. It would be more satisfactory if the curtains could be operated from below rather than from above. This would allow them to be pulled down by the motor and then roll themselves up through the action of the roller spring, the pawl being removed to allow free action.

Wood Flour Is a New Product Made from Sawdust

WOOD flour is made by grinding dry sawdust in the same way that grain was formerly ground in the old-fashioned mills. At the present time it is used in ammunition plants as an absorbent in preparing dynamite. Chemically-bleached wood flour is used in making wood stucco and molding. In fact, wood flour is coming into wider commercial use each day.

A Lawyer's Brief Case Is the Engineer's Knapsack

IF soldiers use knapsacks, why not engineers? So thought a railroad engineer and he straightway devised the knapsack shown. A strap is attached to an ordinary brief case and goes over the wearer's shoulders. As many as a dozen blueprints can be folded and tucked into the pockets of the case. Two straps are sewed on the back to serve as holders for rolled-up drawings that are too big to go into the case sections. For carrying his drawing instruments another pocket is placed just above the two straps. In this way, the engineer can carry supplies along and yet have his hands free.

A brief case converted into a knapsack for holding an engineer's blueprints

Here Is a New Tool for Grinding Your Automobile Engine Valves

THIS new type of valve grinder differs from others which you have seen. While the handle is turned in one direction only, the shank that turns the valve is revolved alternately in opposite directions to produce the forward and backward action so necessary for perfect valve grinding. This unusual action is secured through the use of two gears with segmental teetn, which alternately come into contact with a third horizontal gear on the top of the vertical shank of the device, as shown in the illustration.

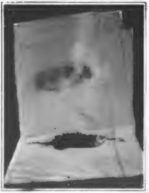
Though the handle is revolved in one direction only, the grinder part reverses itself

Simple Home Tests for Tea and Coffee

THE commonest adulteration in the case of tea is the addition of what is known as "dressing." This is really a matter of dyeing. Poor tea is treated with certain substances in order to give it a fine, black color. The presence of "dressing" in tea may be detected by rubbing a sample of tea in a piece of fine white linen. A pocket handkerchief serves the purpose very well. If the tea is pure, only a little dust will be left on the handkerchief, and this dust may be blown away by your breath. If the tea has been treated, a dark stain will be found on the material.

The test for coffee is equally simple. Fill a tumbler with water and sprinkle a few grains of coffee on the surface of the water. Pure coffee will float, because the coffee bean contains so much oil that each grain is coated with a film of oil. If the coffee has been adulterated, the grains will sink and the water will become discolored. If chickory has been added to the coffee, the chickory grains will sink very rapidly while the coffee grains will continue to float.

Thus easily you can determine the purity of tea or coffee.



Above: Adulterated tea leaves a dark stain on linen. At right: Pure coffee does not discolor the water. At left: Adulterated coffee sinks and rapidly discolors the water

There Is An Increasing Wastage of Adult Life

A CHILD born to-day has about ten times as many chances of living and growing to maturity as had the child born thirty years ago. On the other hand, a man forty years old has fewer years to live than had the man of the same age thirty years ago. Medical statistics prove that infant mortality and preventable diseases are decreasing, whereas degenerative diseases and cancer are increasing. However, the gravity of the wastage of adult life will not be appreciated until there is a nation-wide registration of the sick.

The Blind Have a Deck of Cards All Their Own

CARDS that have recently been devised for the blind have raised letters in the top and bottom corners that reveal their identity. By placing his thumb over the letters, the blind man can tell what cards he holds nearly as quickly as the ordinary person. Dots form the letters. "Two D" means that the card is the Two of Diamonds; "J.H." means the Jack of Hearts, and so on. At first the blind experience a little difficulty in reading the cards readily, but they soon become proficient.

With the aid of the raised letters on the cards, the blind can read them easily

Two Hundred-Yard Drives in Your Parlor

"Fore" you yell, as of old, and hit the golf ball as hard as you like

PARLOR golf would, in theory, seem to have all the benefits and thrills of parlor baseball, as both games are supposed to require much room, but you can make no inventor believe this.

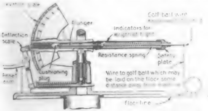
The very latest endeavor to harness down the game to the confines of the largest apartment in your residence, is a machine which lets you whack the ball with all your might and which indicates not only the length of the drive, but also the elevation and deflection, so that you can judge what the ball might have done in the open air, untethered to an unromantic contraption of springs and things.

The machine consists first of a plunger working in a stout tube and compressing a coiled spring as it is drawn out. On the tube are graduations representing yards of drive. The ball is harnessed to the end of this plunger by a stout bit of wire rope, then it is teed or whatever is the preliminary necessary to smacking it clear out of the county, and the golfer soaks it with all the malice he would display in an attempt to reach a green two hundred difficult yards away.

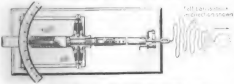
The blow yanks out the plunger against the force of the coiled spring. By the construction of the tube, the plunger is held out at the point where it stops, lest the returning spring smite the golfer with the ball. A pointer indicates on the tube the number of yards the ball would have gone in a real game.

Also, as the barrel containing the plunger is free to swing upward or sideways, there are provided lateral and vertical scales to show whether the ball would have gone straight, and whether in elevation it would have endeavored to emulate the cow that jumped over the moon. Fortunately, no provision is made for measuring the strength and fluency of the language used in case the ball is missed or topped as it is semi-occasionally indoors as well as outdoors.

The machine indicates not only the length of the drive but also the elevation and deflection



When the ball is struck, the plunger is forced out and compresses a coiled spring, causing the pointer to register the length of drive



Lateral and vertical scales show the elevation and deflection of the ball, which is fastened to the plunger with wire rope

A Sandpaper Label for the Poison Bottle Gives Warning in the Dark

PERHAPS the simplest of all devices for protecting people from taking doses from poison bottles by mistake, is the sandpaper label shown in the accompanying illustration. The actual label with its usual skull and crossbones is pasted on a piece of sandpaper large enough to go all around the bottle, so that when you take up the bottle in the night, no matter how dazed from sleep you may be, the rough unfamiliar feel of the sandpaper rouses you, and you recognize at once that the bottle contains poison of some description. The printed label will tell the kind.


The sandpaper label is pasted on a bottle which contains poison

To Make Your Shoes Last Longer, Oil Them Occasionally

WHEN your shoe leather gets dry or hard, you should oil or grease it. To do this, first brush off all mud and then wash the shoe in warm water, drying it with a soft cloth.

While the shoe is still wet, apply the oil or grease, rubbing it in with a swab of wool, or better still, with the palm of the hand. After treatment, the shoes should be left to dry in a warm, but not in a hot place. Castor oil is recommended for shoes that are to be polished. For plainer footgear, fish oil and oleine or any one of the less expensive oils may be substituted with very good results.

A Trolley Hoist for Handling Coal

IN small boiler plants where coal has to be transferred from an outside bin to the furnace doors, the small electric, cord-operated trolley hoist shown in the accompanying illustration solves the problem economically in almost every case. The hoist shown is filled by hand but is self-dumping and self-righting. It has a carrying capacity of a half ton of coal.

The overhead trolley on which the hoist is suspended is carried clear into the boiler-room which is in the building shown in the background, so that one man, with simply the labor of filling the bucket, can keep a battery of boilers supplied with coal all day long. The bucket can be raised or lowered at will while it is traveling to and fro between the coal pile and the boilers by simply pulling on the operating cord.


Although self-dumping and self-righting, the hoist is filled by hand. It can lift half a ton of coal

"Ninety Degrees" says the Regulator

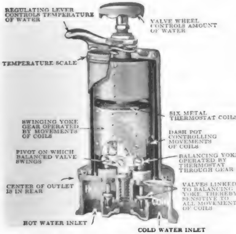
And that will be the unchanging temperature of your bath

AT the top of the contrivance here illustrated, a little lever slides over a small, circular and graduated scale. Set this lever at any point you like—the scale reads in degrees Fahrenheit—open a valve and forthwith your bath water comes out at the right temperature. Once having set this lever, you may let the water run an hour or more; in fact, any length of time, and still the temperature remains unchanged—this in spite of the fluctuation in the supplies of hot and cold water fed to the contrivance. And hot and cold supplies do fluctuate, as anyone who has ever stood under a shower bath knows. Alternate freezings and scaldings are not pleasant.

Even the baby enjoys a bath in which the temperature of the water does not change. Look at the happy expression on his face

The illustration shows the principal working parts and their functions. The big cylindrical coils of the machine are made of two unlike metals welded or riveted together to form a thermostat. The metals expand or contract with changes in temperature very much as does the hairspring on a watch at each tick. The regulating lever at the top controls the amount of this expansion or contraction just as does the "fast" and "slow" lever on a time-piece. Thus the temperature of the water is controlled. The motion of the spirals with changes in temperature are passed along to the balanced valve at the bottom of the machine by means of a yoke hidden in the interior. As a result of the thermostat's action, the balanced valve can open the hot and cold water supplies only to the right degree and proportion necessary to produce the temperature desired.

The machine is of great use in hospitals where many baths of widely varying temperature must be given to patients. Laundries also find the contrivance of value in controlling the hotness of water used on fine fabrics.



The principal parts of the water regulator and their functions. There are six metal thermostat coils

Several sizes are manufactured, from a small one suited to the home, to others of large capacity adapted to the needs of sanitariums, hotels, Y. M. C. A.'s, and similar users. Having only a lever to set, and a valve to open, the machine is easily operated.

The ram walks on the treadmill and operates the separator without being conscious of the indignity

Making a Ram Drive a Cream Separator

A CREAM separator run by ram power is something of a novelty. The ram tries to walk out of the room, but as he is standing on a treadmill, all he does is to operate the machine for separating the cream from the milk. The proceeding is not only inhuman, but expensive in the long run.

A Six-in-One Article—A Revelation in Usefulness

A POCKET article about the size of a fountain pen, which, after investigation, proves to be fully equipped to perform all the arduous duties of a comb, a ruler, a pencil-holder, a nail-file and an envelope opener, has been invented by Mandius J. Munson, of Los Angeles, California. In its simple dress, the article looks like a combined ruler and pencil, but a mere touch transforms it into a comb or into an envelope opener. All of it is made of aluminum, except a small file of thin steel which serves as the nail-file.

The inventor claims it would remind children to keep their hair combed and their finger nails cared for. And all this for two cents!

It's a comb, a ruler, a pencil-holder, a nail-file and an envelope opener all in one

The Diseases for Which Man Blames the Beasts

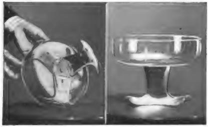
ALTHOUGH animals are not affected by the sicknesses and communicable diseases of man, yet, for some unexplainable reason, the scientists and physicians declare that a whole host of oft-times fatal ailments of mankind are traceable to the beasts. The horse is blamed for spreading glanders, rabies, lockjaw and other diseases of five or more syllables. Dogs and cats are branded as the circulators of rabies, parasitic worms of different kinds, fleas and ticks. The cow is the worst offender. The list of diseases laid at her barn-door is headed with tuberculosis and grows constantly more blood curdling, until we wonder why physicians and scientists consent to the use of milk, butter and cheese which still lead the dietitians' list of nutritives.

Rats, squirrels and fleas spread the bubonic plague. We are prepared to believe that lice and bedbugs, flies and mosquitoes are the rapid transit lines for yellow fever and malaria. We are willing to forego the luscious oyster all the year round, if need be, to avoid typhoid fever. It will go hard with many of us, though, if the fish-day diet must be cut out on account of the possibility of tapeworm which the scientists say fish food carries.

FOR PRACTICAL WORKERS

Fish Bowl with Folding Stand for the Magician

THIS very serviceable fish bowl is really of a collapsible variety. Contrary to appearance, it can be folded up—water, fish and all—and carried beneath



The curved metal legs fold up snugly against the sides of the glass bowl

your coat. To substantiate this statement it can be said that this bowl is the invention of one of the world's greatest "eye foolers"—an old-time magician named Hartz. From an empty cloth he magically produced six of these bowls. This, however, was an unusual achievement which perhaps only Hartz could do. But anyone can hide one of these bowls beneath his coat.

To begin with, the legs fold up flat against the sides of the bowl. A rubber cover, slipped over the mouth of the bowl, keeps the water in. The bowl is hidden under the coat and held in position by the pressure of one arm. As the conjurer waves his cloth, one hand steals beneath the coat and brings out the bowl. The metal legs snap into an upright position by means of a series of rubber bands fastened to each leg.

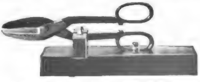
In taking off the cloth, the rubber cover is removed, thus displaying a bowl about 7 in. high and 8 in. wide, brimful of water and swimming gold-fish. The fish are generally known as "three-carat goldfish" because they are composed of three red carrots whittled into shape.

Unequally Adjusted Rear Wheel Brakes Cause Skidding

BRAKES that are not properly adjusted will cause a skid on slippery pavements. A way to find this fault is to drive the car on a dry road, to accelerate quickly, then suddenly to apply the brakes. If one wheel skids and the other keeps turning, this shows that the brake on the sliding wheel is set tighter than its mate.

A Bench Holder for a Large Pair of Tinner's Snips

USUALLY, snips that are used for cutting sheet metal, if they are of medium or large size, are heavy and clumsy to handle, and it is difficult to cut on a straight line. To overcome this, I mounted a heavy pair on a hardwood base about 6 in. wide and as long as the snips. This dimension may be as desired,

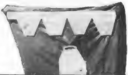


A wood base and blocks to hold tinner's snips so that they are easy to handle

as shown in the illustration. In this way, bench shears are made and they are portable and easy to handle. With this arrangement, it is surprising how straight the snips will cut.—W. E. DAY.

A Homemade Focusing Hood for a Hand Camera

THE plate camera, although a little slower to arrange for procuring a picture, will usually give better results than other kinds, owing to the fact that it can be brought into perfect focus, by adjusting



A hood for the camera back for keeping light from ground glass while focusing

the image shown on the ground glass.

The greatest difficulty in doing this has been in cutting off the side lights. This is usually done with a cloth thrown over the head, which method is uncomfortable and slow.

The hood, shown in the illustration, can be attached very easily and can be telescoped small enough to carry conveniently in the pocket or case. First, cut four pieces of paste-board about 2 in. in width and long enough to fit around the frame of the camera. Two of these pieces should be slightly shorter than the others. Sew the four pieces together to form the frame. In pulling the joints together, at least 1/16 in. should be left to allow the frame to fold when placed in the pocket. A piece of black oilcloth is then procured and cut according to the pattern shown. White oilcloth may also be used just as successfully.

After stitching the V-shaped edges together, the shape is pyramidal. Now place the larger opening over the pasteboard frame, allowing it to lap about 1 in., and sewing it firmly to the frame. Fasten a wire around the opposite or smaller opening, and hem the oilcloth over the wire.

When this hood is placed over the camera, the door of camera can be opened back into it, allowing a perfect view for focusing.—CHAS. CLAUDE WAGNER.

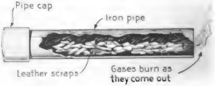
An Indestructible Paper Weight and Blotter

A BLOTTER and paper weight which is practically indestructible, can easily be made by mixing 7 parts (by weight) of gypsum, one part of potato flour and a small portion of water. Just enough water should be used to dampen the mixture. The ingredients should immediately be poured into a well greased mold, and there allowed to dry thoroughly. Then they will be quite ready for use.—W. S. STANDIFORD.

Making Bone Black from Scraps of Leather

THE apparatus illustrated is for the purpose of manufacturing bone black—animal charcoal or ivory black, as it is called. I have made this pigment for black shoe polish or paste, discoloring liquids, filtering, etc.

It consists of an ordinary piece of pipe—the size depending on the amount to be heated, or burned—capped on one end, with the other end left open to make it convenient for filling and to provide escape for the gases. The pipe is half filled with scraps from old shoes and harness. The filled pipe is then laid with the capped end in a furnace or in the firebox of a stove, allowing the open end to extend out where the gases coming from



Arrangement of a pipe for burning leather scraps to make an ivory black pigment

the pipe will burn during the operation. The animal charcoal obtained from the leather scraps is free enough from any mineral substance to need no acid treatment whatever.—HENRY KLAUS.

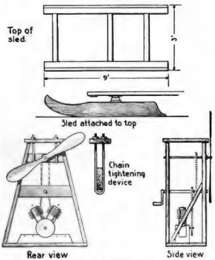
A Sled Driven by a Motorcycle Engine and Airplane Propeller

ANY one who possesses a motorcycle or has access to a motorcycle engine, can make use of it to good advantage for the winter months by using its power to drive a sled. While the power may be applied to the driving wheel that has spikes for pushing the sled, it may also be used to drive a propeller, similar to that of an airplane, which thrusts the sled forward with air pressure. The illustration shows such a power sled.

Details of the sled runner, top and frame that supports the shaft and propeller

While the plans give only general dimensions, they are suggestive of an arrangement to hold the engine and its connections to the propeller shaft. The size of the engine and the sled will determine the size and height of the standards.

In constructing the sled shown, the power plant was fastened to the rear end of the frame, which is about 9 ft. long and 3 ft. wide, constructed of boards about 6 in. wide and 1½ in. thick at the edges; and cross braced with boards 1 in. thick. The runners of the sleds are 4 ft. long.—GEO. M. FOX.



An airplane propeller driven by a gasoline engine is the new motive power for this sled

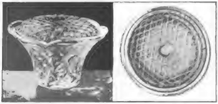
Qualities of Steel and Wrought Iron for Plumbing

STEEL and iron pipes corrode, but tests show that steel pipes corrode far more quickly than those made of wrought iron. The metal used to make steel pipes is a low carbon steel, which resembles wrought iron in softness, except that it has more tensile strength and is purer in quality. It is the latter characteristic which makes it corrode more quickly than wrought iron. Wrought iron contains slag, which is a glassy product. This delays the corrosion to some extent. Wrought iron pipes have lasted more than twenty-five years, if properly protected from frost, while the steel ones corrode very quickly by the action of the chemicals contained in ordinary hydrant water.

Acid and alkali tests show that steel pipes corrode more quickly in salt water than iron pipes. In fresh water, the corrosion is greater for the steel pipe than the wrought iron. An acid test also indicates that the steel pipe is eaten away more quickly.—W. S. STANDIFORD.

A Screen Cover for an Ordinary Flower Holder

PLACING flowers in the ordinary vase bunches them so that they do not fall gracefully. A few flowers may be prettily displayed and made to look



Any jar or bowl may be covered with this screen made of rings soldered together

like a large bunch if each stem is placed in one of the openings in this screen-like covering for a bowl or similar container. Screens for this purpose may be purchased, but they are very easily made at home. I made the one illustrated from small brass rings which cost me only twenty cents. The manner of construction is as follows:

Select from the pantry, a small pot cover that has seen considerable service and that has no tin left on it. It should have enough curve to give it the desired shape. Turn the concave side of the cover up, and place one ring in the center, over the spot where the knob is riveted. Such a cover must have a metal knob as it will be subjected to heat. Around the center ring lay the other rings until the size desired for your screen is reached. Then solder the rings together.

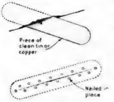
Procure some wire solder and acid; place a small bit of solder on the rings where they touch one another and put on a bit of the acid. When all joints have been gone over, take up the cover with a pair of pliers and hold it over a small flame so that it will be heated evenly and just enough to run the solder. Then take it where it will quickly cool. After cooling, it is ready for use. If it is desired to have a fancy screen, the cover can be plated in nickel, in copper, natural or oxidized, or in the more precious metals. If gold or silver is used, the home-made screen will be as expensive as a purchased one.—J. E. PETTIBONE.

Removing the Stains of Silver Nitrate From Cloth

WHEN using silver nitrate bath solutions in photography, the operator frequently stains his hands and clothing with the nitrate. It is not very generally known that certain chemicals will remove the stains, or will render them invisible. The following is applicable to clothing: Dissolve in water to a moderate concentration, bichromate of mercury, obtainable at drug stores, and moisten the spot with it until the stain becomes invisible. Or dip the fabric into a copper chloride solution until the stain has disappeared, and then wash it with a fairly concentrated solution of hyposulphite of soda, followed by a thorough rinsing in water. Or dissolve one part of mercuric chloride, and one part of ammonium chloride in eight parts of water and dip the fabric in the solution. To remove the stains from the hands, a cloth immersed in one of the above mixtures and rubbed on the stained portion of the hand, will usually serve. Some people use potassium cyanide, but the poisonous property of the cyanide makes its use dangerous.

Soldering a Crack in an Old-Style Copper Bathtub

SOMETIMES a heavy coating of solder is run over a crack in an old-fashioned copper bathtub, or other tank, sheathed in wood. Eventually the edges of a portion of the metal become corroded and through expansion and contraction of the metal, the crack extends up into the solder. To repair this properly, clean the metal thoroughly, then take a piece of clean tin or copper, wider and longer than the crack, and insert it in the opening as shown. Then work it around until it is in the position of the dotted lines. Fasten it with brass tacks or bright nails. Apply the soldering flux and run the solder, making it heaviest over the crack and the nails.—JAMES M. KANE.



Placing metal strip back of break

Rebuilding a Wrecked Automobile To Make a Racing Car

THE owner of a wrecked car concluded it was only fit for the junkman and left it in the corner of his lot where it was hauled after the accident. The nephew of the owner decided that it could be made of some use, as the engine needed only a few new parts to make it like new. The cost of the materials he bought did not exceed $15.

The damaged body and mud guards were stripped from the chassis frame, and the bent and damaged radiator was straightened and repaired. The gasoline tank was moved back 3 ft. from under the front seat, which left a space in which to lower the seat to the position desired. An extra piece of gasoline pipe bridged the gap made by moving the tank back. A floor was laid on with tongue and groove mast and bolted to the chassis. The length of the boards was kept the width of the chassis instead of extending to the wheels as in the old car. The steering wheel was then lowered. This was one of the most difficult parts of the work. A new hole was cut in the dash board 3 ½ in. lower, giving the wheel the correct angle from the low racing seat. The old seats were used, being cut out of the center to fit the seat to the narrowed car. The cut pieces were brought together and braced on the inside with four metal strips. To give a firm back support, the seat was braced to the floor with metal angles securely fastened.

The old tool box was tightly fastened in the rear of the gas tank, back of the seat, and used for an extra seat by placing cushions on it. The hood was first cut out from cardboard and then from tin and hammered into shape on a wooden block. This covered up brake pedal, clutch pedals, reverse pedals and protected the switch box. The result, after the car had been painted, can be seen in the upper illustration.

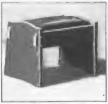
Carefully look over a supposedly wrecked car before selling it for junk, for the engine may still be in perfect order, or unharmed to such an extent that with slight repairs it can be put in shape for further use in an automobile, or for a stationary power plant. Some other parts may be used in rebuilding another car. Another transformed car is shown in a second photograph. The owner of this car was not trying to save money. He merely desired a car made according to his own ideas. In this case, a new chassis was purchased, including mud guards, tool box, gas tank and headlights. He floored the chassis, put in two separate seats made according to his own design, and fitted the car with a top of light awning construction, with iron piping screwed to sockets in the floor, removable at will. For the top, brown canvas was used. The wind shield was reduced to half size to conform to the shape of the car. This car is half roadster and half racer.

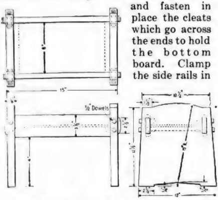
A built-over and refinished car that was once supposed to be wrecked beyond repair

A semi-roadster and racer was desired, so the car was specially built on a new chassis

Making an Oak Footstool in Mission Style

THE footstool shown, differs slightly from the conventional style. It is thoroughly practical and is easy to make. Made in oak, it is a serviceable and pleasing piece of furniture. Select choice material. The ends are cut first. Lay them out carefully, drawing the mortices on both sides so that both sides can be cut. This ensures a neater and more accurate job. Cut the outline of the ends on a bandsaw, following the line closely. The mortises are then cut, working from both sides. After these are ready, smooth the edges; the straight edges with a plane and the curves with a wood file. The side rails are next planed to width and the ends fitted to their respective mortises. Make and fasten in place the cleats which go across the ends to hold the bottom board. Clamp the side rails in place as they are to be in the finished piece. Next bore the holes for the ½-in. pins. These pins are cut from the left over scraps of wood. Apply glue in the holes and drive the pins in place. The heads of the pins can be finished with a rounded, flat, or pyramid point as the taste may dictate. Finish the stool with a good standard oil stain.


The stool as it appears when finished

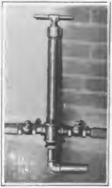

Details of the oak pieces which enter into the construction of the mission footstool

Asbestos Used in Place of Copper for Laboratory Hoods

IT has recently been found that asbestos can be substituted for copper in constructing the flue pipes for the hoods, in chemical laboratories. It had formerly been thought that nothing but heavy sheet copper would withstand the corrosive action of chemical gases and fumes. The present high price and scarcity of copper, however, has made a substitute almost imperative and in constructing some new laboratories in Brooklyn, application was made to a large manufacturer of asbestos products, for asbestos flue pipes. As a result, pipes square in cross section and consisting of asbestos board ¼ in. in thickness were made and installed. These pipes are gas tight and as asbestos is entirely unaffected by corrosive gases, they will undoubtedly last a life time.—FLOYD L. DARROW.

How to Make a Force Pump of Pipe and Fittings

WITH a few pipe fittings and pieces of pipe a very serviceable force pump can be constructed that may be used to open up drains, water pipes and the like. The main pipe or pump barrel consists of a piece of brass pipe into which a piston is fitted snugly. This piston is operated with a small pipe, having a crossbar made of a tee and two pieces of a pipe at the upper end for a handle. The long pipe to which the piston is attached runs through a packing nut fitted into a pipe cap which covers the pipe end. The lower end of the barrel screws into a reducing cross, having connection as shown. Two check valves are attached to the side nipples. Water may be supplied from either or both sides.—C. H. THOMAS.


A force pump made of pipe and fittings

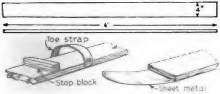
Homemade Pair of Skis

A simple method of making skis without having to bend the wood

BY following the design here illustrated, it is comparatively easy to construct a pair of skis with which one can travel on the surface of the softest snowdrift without sinking.

Procure two hardwood boards about 6 ft. long, 4 in. in width, and ½ in. thick. Although soft wood will do, hardwood will answer the purpose better, as it polishes easier, and the smoother the ski is on the bottom the better it will run.

A leather strap is tacked to the upper side of the ski, so as to form a loop. This should be placed exactly in the center of the ski and should be just large enough to admit the toe of the shoe. A small block of wood is fastened just back of



The straight wood runner is pointed with a piece of sheet metal curved at the end

the toe-strap in such a position as to fit into the hollow part of the shoe, just in front of the heel.

A piece of heavy tin or sheet metal is used for the front part of the ski. This should be about 1 ft. long, 4 in. wide at one end and tapering to a blunt point at the other. It is fastened to the under side of the front of the snow-shoe, with the pointed end turned up. The nail heads and all sharp points of tin should be filed off so as to make the under surface of the ski as smooth as possible.—PETER J. M. CLUTE.

How to Make Knitting Needles in a Speed Lathe

KNITTING for our soldiers seems popular with the ladies as a method of doing their bit. It may be of considerable interest to know that knitting needles can be made easily and cheaply by students, in shops where speed lathes are available.

Red cedar is the best wood to use. Secure straight grained sticks and joint them straight and true. Rip out pieces about 1 in. longer than the length desired, and with a side of the cross section only slightly greater than the required diameter of the needle.

Needle sizes are about as follows:

For sweaters, dia. .200 in., length 14 in., Twist drill No. 7.
For helmets, dia. .175 in., length 13 in., Twist drill No. 16.
For wristlets, dia. .135 in., length 12 in., Twist drill No. 29.

Secure a piece of cold rolled steel ½ by 2 by 5 in. and drill a hole in the center of each end, in such a manner as to allow it to be bolted to the face plate of a speed lathe through the screw holes on the face plate. It should approximately center up on the lathe. With a twist drill of the size of the needle required, drill a hole

through the piece of steel while the lathe is running. Countersink the face of this hole.

Clamp a jack plane, bottom up, in a vise and run the cedar sticks across the plane to remove the corners.

Start the lathe on high speed, and then feed the cedar sticks through the hole in the piece of steel. A little pressure may be required, but if the pieces are not too large, they will feed through nicely and leave a well finished surface.

To make the heads or knobs, rip some cedar into pieces slightly greater than 3/8 in. square and about 42 in. long. Drive these through a 3/8-in. dowel plate. Fasten a piece of pine about 2 in. thick to a face plate, and, while the lathe revolves, drill a 3/8-in. hole through the center of the pine chuck. A 3/8-in. drill is best, but a 3/8-in. auger bit will do. Chuck one of the 3/8-in. pieces of cedar in the hole in the pine piece. With a drill the same size as the needle, drill a hole through the center of the cedar as the lathe revolves. Next, remove the cedar from the chuck and cut it into 3/8-in. lengths. Glue one of these lengths on one end of the needle. When dry, chuck the needle in the hole in the steel plate (a little shellac will hold it) and turn the head down. The needle may be sanded lightly by allowing the free end to turn in the palm of one hand as the lathe runs, and by applying the sandpaper with the other hand.

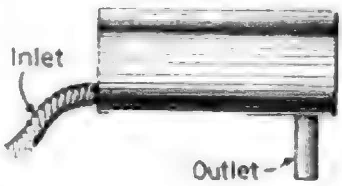
The needle may now be cut to length and pointed on the side of an emery wheel, or on a revolving disk of sandpaper, glued to a chuck. French polish the needle by hand, with a little shellac and a drop or two of linseed oil. The varnish may be rubbed in with a piece of cheesecloth.—Daniel Green.

Making a Lock Washer from a Coil of Spring Wire

A GOOD lock washer for emergency use can be made by cutting a single coil from a compression spring. This will have the "set" of a regular lock washer. The only difference is that the washer is made of round instead of flat stock. An added point in favor of this device is the ready availability of springs.

A Heater for the Sidecar of a Motorcycle

A HEATER for a sidecar can be easily made from a tin can—a gallon oil can will do—and a flexible tube, such as is used to supply warm air to the carbureter in automobiles. Cut a round hole in one side of the can, and in it fasten a tube, which passes through the floor of the car, to serve as the exhaust outlet for the gases.



An old can used to heat a sidecar

One end of the flexible tube is slipped over the filler nozzle of the can and clamped in place with a hose clamp or a wire wound around it and twisted tightly. The other end of the tube is fastened to the tail pipe of the muffler in the same way, a hole being cut in the side of the sidecar allowing the tube to pass through. If some covering, such as a storm apron, is used, the car will be as warm as desired, even in the coldest weather.—N. Drynan.

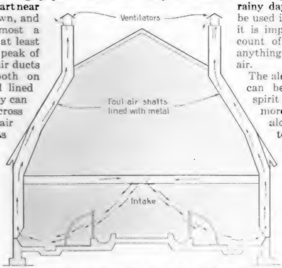
Caring for Rubbers to Make Them Wear Longer

RUBBER overshoes, like everything else just now, are expensive, and sometimes hard to get at any price. Any suggestion as to how to make them last longer, will, therefore, be appreciated. If you will give them a little extra care and attention you will be more than repaid for the trouble.

All oils, fats, milk or acids will cause rubber to blister, soften and wear out quickly. Therefore keep them away from your overshoes. When soiled, wash the rubbers with lukewarm water. Do not put them near a hot stove or steam pipe, as the heat will make them crack. Do not leave the rubbers outside of the house, exposed, for sunlight will heat and crack them. Freezing will also make them brittle, so that they are likely to crack when they are put on. Of course it would be rank foolishness to try to wear high heeled rubbers on low heel shoes, or low heeled rubbers on high heeled shoes. In either case, the rubbers would very soon break out at the heel.

A Practical Ventilator for the Dairy Barn

THE essential points required for obtaining the best results with this system of ventilation are: The stable room must be as nearly weather-proof as possible. To keep out the cold air, insulate the walls and ceilings with matched lumber and building paper. The foul air-vent shafts start near the floor, as shown, and run up in almost a straight line to at least 2 ft. above the peak of the roof. The air ducts should be smooth on the inside and lined with metal. They can be circular in cross section, as the air goes in spirals, as in windstorms. Sharp bends in the shafts must be avoided as often as possible. The top of the shaft should be rain-proof. These shafts may be covered with the ordinary stationary or revolving ventilator such as is used on smoke stacks.



Positions of ventilator shafts in a dairy barn to provide a means of admitting fresh air and of removing the foul air without drafts

Fresh air ducts open into the ceiling of the stable, directly over the cows' heads. Make the air intakes in the outside walls as far below the outlet at the ceiling, as is practical. It is well to do this, because if the intake is level with the outlet in the ceiling, the warm air near the ceiling will escape, reversing the flow of air and exhausting the heat instead of letting in fresh air. Fresh air ducts give satisfaction when evenly distributed in front of the stock, while the foul air ducts can be made large and fewer in number.

The sketch shows how this practical and well-tried system works when the cattle in the stable face the center of the barn. It is inexpensive to install in new or old barns.—W. E. FRUDDEN.

Making Briquettes for an Alcohol Stove

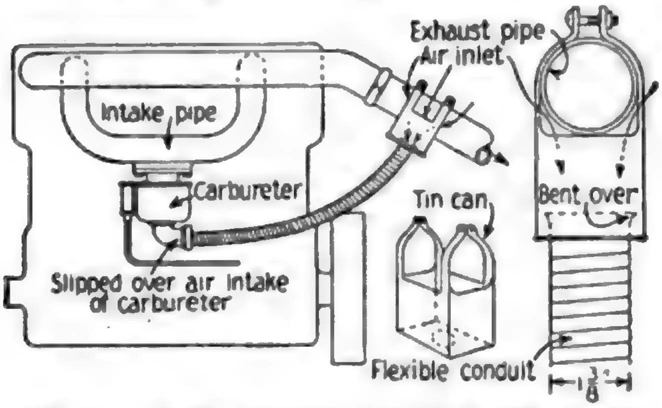
IN drug stores and at stationers are seen small stoves that use briquettes of solidified alcohol for fuel. These stoves are very useful for boiling coffee, cocoa or for other purposes where an intense heat is desired. They are also very convenient for campers use on a rainy day, as they can be used in a tent, when it is impossible on account of rain to cook anything in the open air.

The alcohol briquette can be used like a spirit lamp, and it is more handy. The alcohol lamp has to be carried in an upright position to keep the contents from spilling; while the briquette is fluid only while it is burning. When not in use, it solidifies and can be carried in any position.

The yellowish, doughlike substance is easily prepared. It is made as follows: In a vessel of suitable size and kind, 1,000 parts of denatured alcohol are heated by a water-bath. When the fluid reaches a temperature of 140 deg. F., 35 parts of dried and grated Venetian soap and 2 parts of gum lac are added. The fluid is then stirred until the substances are completely dissolved. Then the mixture is poured into empty baking powder boxes, or if a person has a briquette stove and has saved the cans, the mixture can be used to refill them. On cooling, the mixture solidifies in the cans. In these stoves, the flame is extinguished by replacing the lid. The contents can thus be preserved until the alcohol in the mixture is exhausted. Do not use wood alcohol in making the substance, as its fumes are dangerous.—W. S. STANDIFORD.

Homemade Hot Air Intake for a Carbureter

TO increase the mileage per gallon of gasoline, the air should be slightly warmed before it enters the carbureter. A very simple and practical method of supplying this heated air is shown in the



Tin can on the exhaust connected with metal pipe to supply hot air to the carbureter

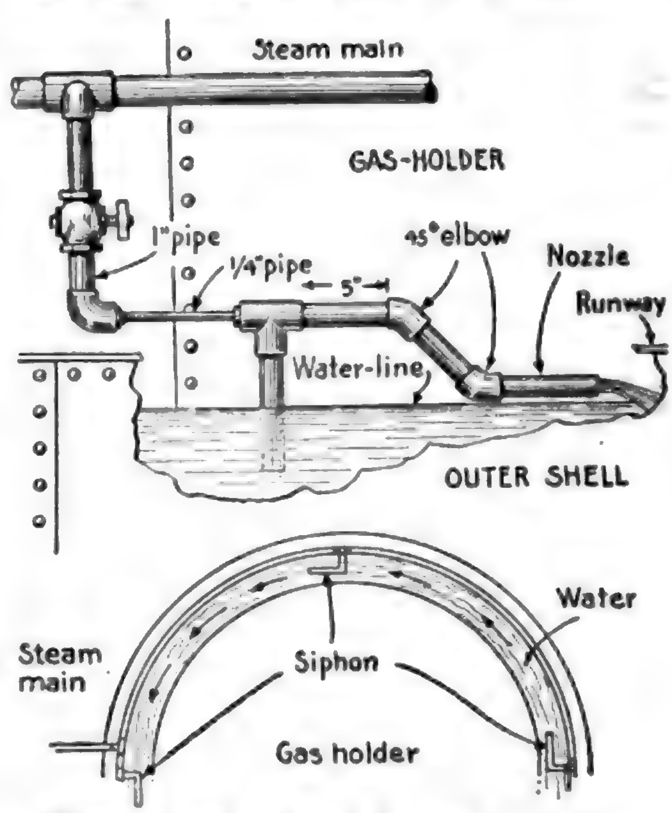
illustration. The main body of the device consists of an oblong tin can cut out and fitted over the exhaust pipe, as shown. A hole is cut in the bottom of the tin can and the end of the piece of flexible metal pipe, such as is used for electric wire insulation, is slipped into it and connected with the air-intake of the carbureter. This is a satisfactory homemade accessory which will give more miles to the gallon of gasoline, quicker acceleration and less carbon.—P. P. AVERY.

Adjusting the Foot Pedal to Prevent Wear on Gears

IT may be difficult to believe that the adjustment of an automobile clutch pedal has everything to do with the life of the transmission gears and the clutch parts. If the pedal is set so that it moves through a greater part of its arc before it commences to release the clutch, then it is more than likely that it will not wholly separate the clutch members. In that case, the gears will clash in "changing" and they will be prematurely worn out. Besides "changing" will be a noisy operation. If the pedal is set so that when it is "back" it strikes the floorboard, it is almost certain that the clutch members are not engaged as tightly as they should be and that they are slipping—though so slightly as not to be noticed—with a consequent wearing of the surfaces. Worse than this, the clutch is being held "out" all the time against a powerful spring, and the part that takes the thrust of this spring at such a time, is an expensive ball bearing, which is sure to show the effects of such service.

Circulating Water in a Gas Holder to Prevent Freezing

THE ordinary observer would think that a gas holder is sturdy enough to be unaffected by freezing water. But the fact that the upper drum, holding the gas, is surrounded by, and moves up and down in water, renders it necessary for the gas companies to safeguard their holders against freezing, as it is vitally important that the holders move freely. One gas company prevents the water from freezing by keeping it in circulation with a system of steam siphons, placed at intervals around the holder. The water ejected from the nozzle of each siphon, communicates a forward impetus to the water in front of it and in this way the water is kept in continuous



Siphons made of gas pipe and operated by a steam jet to keep water in circulation around gas holder. This prevents freezing

movement around the holder. The siphons are built of 1-in. pipe excepting a short piece which is made of 1¼-in. pipe. The steam main is, of course, the largest.—JAMES M. KANE.

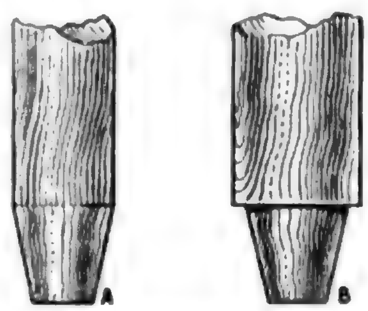
Tricks of the Trade

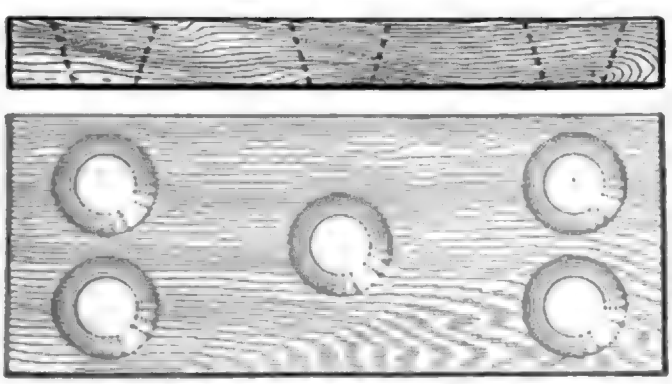
Under this head each month there will appear one or more articles describing methods and short cuts in shop work practice

Burning Holes in Patterns

PATTERN makers and other wood workers are often at their wits end to find a way to make smooth, tapering holes, especially in a piece of wood which is cross-grained, or in which the hole has to run diagonally with the grain.

Ordinarily a sharp taper reamer may do the work, but one of just the right size, is





Tapered holes accurately sized by burning with wood points rapidly revolved in them

not always at hand, and when a hole of a particular size and bevel is required, the taper reamer will not do the work.

On a job recently, there had to be five smooth holes, of the same size and bevel, through a piece of 5/8-in. white-wood. The holes were 5/8 in. at the small end, and 1 in. at the large end. They were bored with a sharp bit, a little smaller than they were to be at the small end, then beveled with a sharp knife to nearly the size at the large end. A piece of hard wood was then turned to nearly the size and taper required, as shown at *A*. This was revolved at medium speed in each hole until it burned a little. Care was taken not to let it burn too much. This was repeated until the holes were almost the size and bevel required. Next, another plug *B* was turned the exact size the holes were to be when finished. Then the holes were carefully finished with this.

It is a good plan to turn a shoulder on the finishing plug so that the holes may be just alike. Finish the holes with fine sandpaper.—C. E. STONE.

Tempering a Chisel to Cut Stone or Bricks

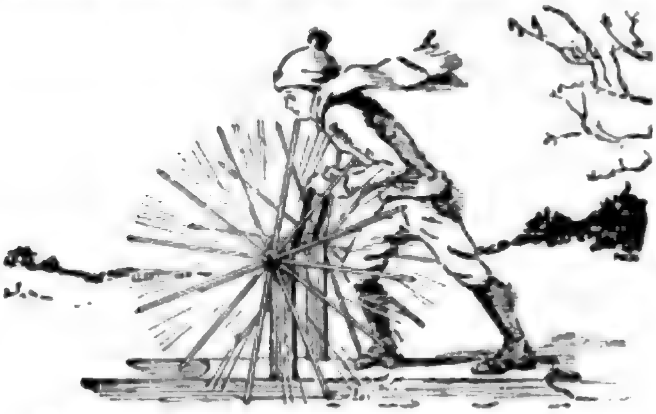
A CHISEL to cut stone masonry work must be tempered to a different degree of hardness than those to use for other work. Before tempering, it should be sharpened on an emery wheel, as tempering puts a hard surface, or a sort of skin, on the cutting edge, which grinding removes to a certain extent, no matter how carefully the grinding is done. In grinding stone cutting tools, do not grind the cutting edge with too narrow an angle, but allow the edge to have an angle of over 100 deg. This gives a sufficient amount of metal back of the sharp edge, to enable it to withstand the shock of the blows. Too sharp an angle on the tool edge would cause it to break at the first blow. After the grinding is done, put the chisel into the fire and heat it to a cherry-red color, then dip the point of it into cold water—holding the chisel in a vertical position. Do not dip it all in, but leave some heat in the shank. Quickly brighten the point with a file or emery cloth and watch the colors closely as they travel down to the point. When a light-blue is reached, dip the entire chisel into cold water. It is then ready to use.—W. S. STANDIFORD.

Mercury Used for a Thrust Bearing on an Upright Shaft

A NEW bearing is being used on a generator set, wherein the main shaft stands vertically and supports considerable weight. Instead of being supported by collars or an end thrust bearing, a small quantity of mercury is placed in a pocket at the lower end of the shaft.

Hand Sled Propeller Made of Discarded Buggy Wheels

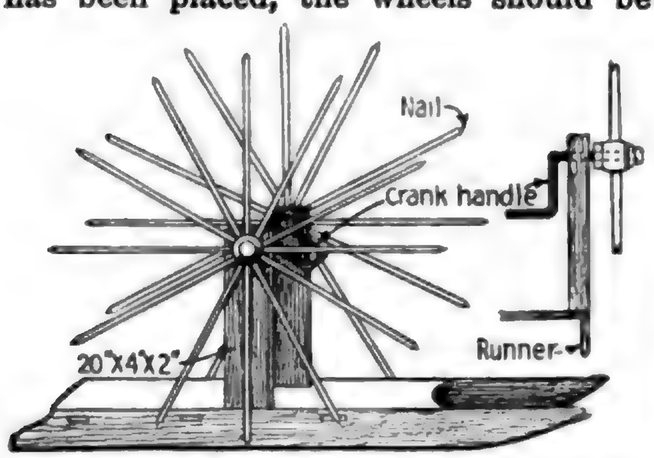
FOR ice and smooth, level, well packed snow, this is a very fine sled propeller. It is made of two old buggy wheels with the spokes sawed off just where each one enters the felloes. The



Propelling the sled over smooth snow and ice by turning the shaft between the supports

axle holes in each hub should be plugged with wood.

For a shaft, take a ½-in. rod and bend it in the form of a crank. To support this shaft, two hardwood pieces 20 in. long, 4 in. wide and 2 in. thick are needed. These support posts should be fastened to the top of the sled by means of screws. A ½-in. hole, bored through the top of each, should be slightly reamed out with a hot iron in order to make a suitable bearing for the shaft. When the shaft has been placed, the wheels should be



The buggy wheels are fastened on the ends of a shaft bent to form a crank in the center

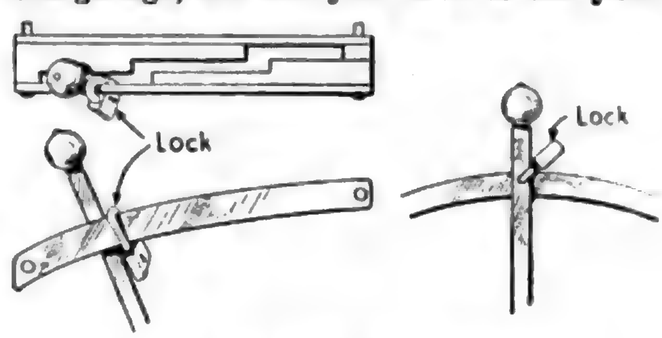
fastened in place on either end of the shaft. This is done by driving each end of the shaft into holes bored through the wooden plug in each wheel.

The end of each spoke should be sharpened and an 8d. finishing nail driven in up to the head. By using a file, this head may be sharpened to a point. Thus the nail heads will do the pushing without allowing the spokes to slip on a smooth surface.

It is evident that when a boy, sitting on the sled, turns the crank, the wheels will revolve, thus easily propelling the sled over the ice or snow.—F. E. BRIMMER.

The Most Convenient Way to Lock a Motorcycle

IF it's a three-speed motorcycle that you have, simply lock the gear-shifting lever in neutral position by snapping your lock in the guide-slot. This method has the advantages over the ordinary scheme of chaining and locking the wheels, in that you will have no difficulty in moving your machine about in the garage, nor will you have to soil your



Two ways of locking a gear shift lever on a motorcycle to prevent its being stolen

hands while putting the lock either on or off. This same principle can be used if you have a single-speed cycle, by drilling a hole through the lever and the guide-bar, so that the lever can be locked when in the "free" position. Always remember that it pays to buy a good lock.

How to Straighten a Bent Rim on a Headlight

LAMPS are about the first part of an automobile to sustain an injury in a wreck or accident, as the spun metal is very thin and will become dented with a slight blow. Dents on the rims or other parts of the lamp may be straightened as follows: Take the other lamp and pour melted babbit metal into the part that is bent in its mate. When the metal has cooled, it is used as an anvil to straighten the bent part. For hammering the metal, use a rubber or soft faced hammer.

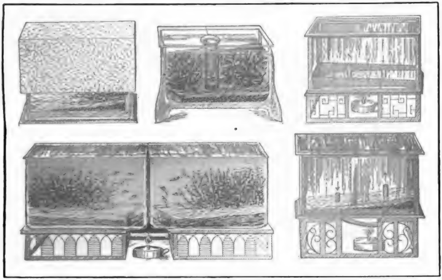
How to Make an Aquarium for Tropical Fish

ORNAMENTAL tropical fish which are kept in cool or cold water during the winter do not show their gorgeous color effects. Their appetites are not what they should be and the fish are slow of movement and lazy in actions. Their liveliness leaves them. No longer do they disport themselves as is their wont in warmer waters and they rarely multiply in this, the best season of the year, winter.

Tropical fish require a temperature of at least 60 deg. F. To keep the water at this temperature in winter, especially designed aquariums are built. But ordinary aquariums may easily be adapted to give equal satisfaction along these lines.

If one of these simple aquariums stands in a room which is heated during the day, no complicated heating system need be used to keep the water at a constant temperature during the night. A cardboard box, large enough to completely cover the tank is placed over the aquarium at night. The sides of the box should reach to the bottom of the aquarium and leave no more than ⅛ or ¼-in. play on either side. This is a device which will suffice in most cases, as it effectually keeps the water at the required temperature. In the morning the cover should, of course, be removed.

Heating the water of the aquarium directly, will give better satisfaction than the above mentioned method. An apparatus with which to do this, besides being more efficient and easy to install in almost *all* aquariums, has the advantage of being absolutely fire proof. This device consists of a tall, not too narrow, cylindrical glass jar placed in the water of the aquarium. This jar is filled with lamp oil and lighted with one or more Nürnberger night lights which consist of a wick dipped into paraffin. It is held erect by a wire, radiating outward and the whole apparatus is supported by three corks to which the wires are attached. If these lights refuse to burn in the glass, a small tubing of either rubber or glass is inserted to insure fresh air reaching the wick. Although a large quantity of heat is lost by this method, it is absolutely safe and no accident can ever result from it. Electricity may



A cardboard box covering for an ordinary aquarium at night. An aquarium heated with a candle lamp which is placed at the bottom of a glass tube set in the water, and which applies heat from beneath the receptacle. Also methods of heating an aquarium with inclosed tubes

be substituted for the lamp oil, if a bulb is placed in the jar.

The other methods of heating the aquarium differ from those just described in that a lamp is placed beneath the tank, which must stand upon a platform or framework of artistically designed ironwork. But only those aquariums may be so heated which are either built entirely of glass or those which have zinc bottoms. Both are placed in pairs with their refuse corners facing each other. Those made entirely of glass receive an extra piece of copper placed about an eighth of an inch from the glass bottom which the flame must strike. Aquariums with sheet metal bottoms do not need this extra piece of copper, when this method of heating is used.

Two other ways in which the aquarium may be heated, remain to be explained. Both work on the principle of water circulation. This method produces the best results, for none of the heat is wasted. One of the tanks receives a small box-like insertion, made of sheet zinc, which should cover the bottom of the tank. Two tubes, one shorter than the other, are soldered to the top of the box. The tank may then be arranged like an ordinary aquarium so that only these tubes, covered with fine wire netting, project out of the sand. The water, in the box immediately below the soil of the aquarium, is heated with a small lamp. The water, as soon as it becomes warm, rises through the long tube, while the shorter one lets the cold water sink into the box. In this way, a continuous circulation is kept up. Another advantage of the box is that it does not heat the soil of the aquarium, which would materially injure the plants.

The other and last method is similar to the preceding one. Instead of the box, a U-shaped piece of tubing is soldered to the bottom of the aquarium. The curve, which projects about an inch below the aquarium, is heated. All heatable aquariums should be covered with a piece of glass when heated, unless a glass jar is used. Then the protecting glass cover should have a large opening, corresponding to that of the jar, and it should be so situated that the heated air may escape and a fresh cool supply reach the flame.—DR. E. BADE.

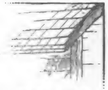
A Secure Fastening for an A-Shaped Sign

LUNCH room and other sidewalk signs in the shape of the letter A will not stay in place on a windy day. Devices which might hold them steady are usually inconvenient to pedestrians. But with the fastening shown in the illustration, the holding device at the base of the sign may be set below the surface of the walk, where it will be in no one's way. When the turnbuckle is tightened, the sign cannot be blown away. The eye may be on a stake driven into the earth where sidewalks are placed on the ground, or where a sign is used outside of the walk; but in the case of a cement walk, the eye may be set in the gravel or grout when the walk is laid. The holding device may consist of a chain or of a rod with an ordinary turnbuckle in its center. The chain or rod is attached under and at the top of the boards and has a hook at the lower end for making connection with the eye in the walk.—G. P. LEHMANN.

Bolt with turnbuckle fastened in sidewalk

Using Shingles to Make a Thatch-Like Effect at Eaves

PROBABLY every artistic soul has longed for a little home with droopy roof lines that stoop to meet the climbing ivy on the walls. You can go a long way toward getting it by making a bouquet of your shingles. Bore a hole through the first bunched line of shingles extending over the eave, and wire them in place. Of course it is necessary to slope the rafter ends and to put on the first sheathing board at a slope which will take the bunched shingles.—W. B. SMITH.



Shingles bunched to make the thatch effect

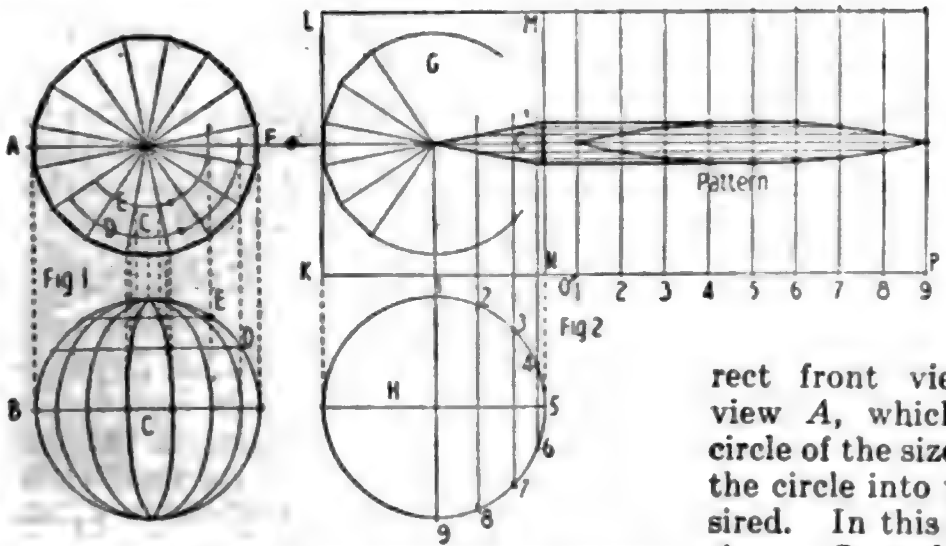
Simple Designs for Sheet Metal Working

IX.—Development of patterns for approximate spheres

By Arthur F. Payne

Former Director of Vocational Education, Columbia University

THE name "Approximate Sphere," given to the problem illustrated, will very likely need explanation to some of the readers of this series. The common names for this problem are "Gored Ball" and "Slab-sided Ball." A sphere is an object that presents a perfect circle from all points of view. The sphere, shown in Fig. 1, presents a



A "slab sided" ball is an appropriate ornament as a finial on top of a flag pole, steeple or turret

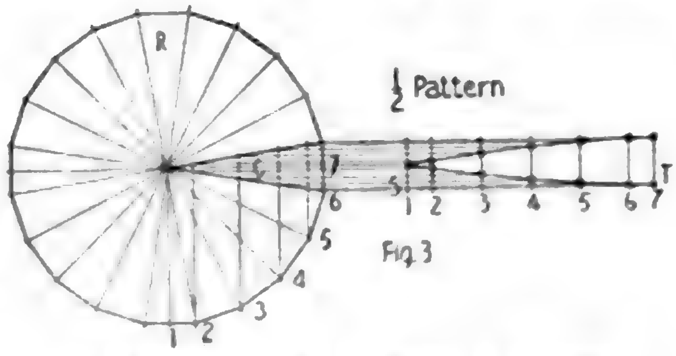
perfect circle from the front view only, the top view is an "approximate circle," that is, it is almost a circle, being divided into sixteen parts, which are variously called gores, slabs, panels or sections. In this article, these parts will be called "sections," as this is considered the correct name.

The practical application of the problem would be as a finial on top of a flag pole, steeple or turret, or as an ornament on buildings.

The interesting feature about this problem is that the methods used are the same as those used in the elbows and tee joints, illustrated in previous numbers. In fact, to develop the pattern for one of the sections, we must first of all recognize the fact that each section is merely part of a cylinder or pipe. This may seem somewhat difficult to see at first, but as the directions are followed and the pattern is developed, it will become clear. This particular point is illustrated by *G* and *H* of Fig. 2.

There are several different methods of developing the pattern for this problem. For the sake of better understanding and practice, three methods are illustrated. However, as they are worked out, it will be seen that they are all based on the same principle.

The method of obtaining the correct front view of the sphere is shown in Fig. 1. This is not absolutely necessary to the development of the pattern, but is given because it is often useful in making a sketch for the customer. To get the correct front view; first, draw the top view *A*, which is done by drawing a circle of the size wanted and then dividing the circle into the number of sections desired. In this case there are sixteen sections. Second, draw the front view *B*. This presents the problem of drawing the true picture of the section *C*. We can very easily get the width at the widest part by dropping down the dotted lines as shown in the drawing, but we have to find some way of drawing in the curved



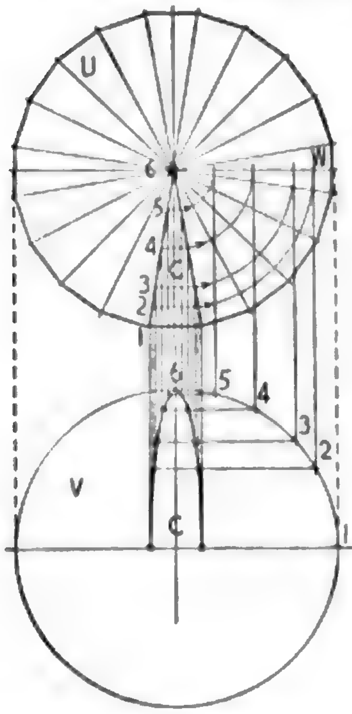
A short cut method in which no bottom view is required for obtaining pattern

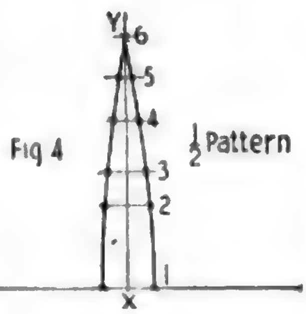
line to complete the section from the front view. This is done by drawing the arcs *D* and *E* on the top view. This is for the purpose of locating points on the

section *C* so that we can get the correct widths down to the front view. The arcs *D* and *E* are swung up to the line *F* and then dropped down (see dotted lines) until they strike the edge of the sphere on the front view, as indicated by the crosses. Next, run the lines *D* and *E* across the front view. Then drop the dotted lines from *D* and *E* on the top view down until they cross the lines *D* and *E* on the front view. Connect these crosses with a curved line and you have the true front view of the section *C*.

Developing the Pattern

The development of the pattern for the section is as follows: First, draw the cylinder *G*, Fig. 2, with its bottom view *H*. Draw the section *C* on the cylinder the same size as section *C* on the top view of Fig. 1. Now, if the rectangle *K-L-M-N*, Fig. 2, is thought of as representing the front view of a cylinder, or round pipe, it will be seen that the section *C* is simply a slice of that cylinder. After this is seen, the problem becomes a very simple one in which we use exactly the same methods of development as we used in the elbow patterns. Second, draw the bottom view *H*. Divide one-half into eight equal parts. We only use one-half because the section only runs half way round the cylinder. Third, draw the base line *O-P*, obtaining the correct length by stepping off the eight spaces from the bottom view *H*. Run the lines from the points on the bottom view upward until they strike the section *C*. Then run them over until they intersect the same numbered line coming up from the base line *O-P*. Make a cross at the point of intersection and connect with a curve. Then you have the complete pattern for the section *C*. Cut out sixteen of these. Bend them to the form of a half circle and solder them together. No allowance is necessary for laps or seams.





Another interesting method of developing the same pattern

A "short cut" method is shown in Fig. 3, in which the top view corresponds to *G* in Fig. 1. No bottom view is needed because the lower half is used as the bottom view, and the section division lines designate the bottom view points. Lay off the base line *S-T* by stepping off the distance as numbered. Run the lines upward until they strike section *C*; then over to the right until they cross the same numbered lines coming up from the base line. Mark the intersection with a cross. Connect these crosses with a curve, and you will have one-half* of the pattern. By repeating this operation farther along, the entire pattern may be developed.

A Simple Method of Developing the Pattern

Another interesting method of developing this pattern is shown in Fig. 4. It will be seen that the drawing of the top view and the front view is the same as in Fig. 1. The steps taken are: First, draw the top view *U*. Second, divide section *C* into any number of parts, as numbered from 1 to 6. These are swung around to line *W*; then dropped down to the front view circle; then across to section *C*. Third, drop the lines down from section *C*, top view until they cross the same numbered lines running across section *C*, in the bottom view. Mark with crosses and connect with a curved line. This will give the correct front view of section *C*. Now draw the line *X-Y*. Get the correct length by stepping off the distances, as indicated by the same numbers on the circle. Then with the compasses, measure the width of section *C*, front view, line one, and set off the same width on line one of the pattern. Do the same with the other lines and you will have the pattern for one-half of section *C*. After the pattern is developed it is an easy matter to build up the ball, making an almost perfect sphere in the completed ornament.

Sound Advice on Coal Saving

To the man with the shovel

(Prepared in the office of the United States Fuel Administration for the Popular Science Monthly)

WITH trillions of tons of coal in the ground, America is hard-pressed to furnish coal for munitions factories and steel plants; for the Army and Navy; and for domestic consumption.

There are not enough coal cars to transport coal needed for American consumption and for the maintenance of our Allies. If there were enough coal cars, there would not be enough locomotives to draw them. If coal cars could be provided, there would not be enough terminal trackage to handle the enormous increase of freight caused by the war.

The United States Fuel Administration asks that the American people, through measures of conservation in factory and home, fill the gap of fifty million tons which even the increased production of 1917 fails to fill.

Americans have customarily been wasteful of coal. There has always been plenty of coal, at a cost that has seemed very moderate. Why bother to be economical in the use of it? The average man-of-the-house, who manages his own furnace, might be more frugal of his fuel if he realized that every shovelful of coal that he throws into the greedy maw of the ogre in the cellar, represents in money value the price of a loaf of bread or a pint of milk.

From the viewpoint of people fairly well-to-do, the saving of a shovelful here and there has been too petty an affair to be worth considering.

Today, however, we are confronted by a new situation. Now it is everybody's business to save coal. Now coal means munitions and other war supplies. It means transportation. It means the winning of the war.

Yet, if every householder in the United States would save one kitchen shovelful of coal each day in the year, the total saving thereby accomplished in a twelvemonth would amount to 15,000,000 tons.

This quantity would keep 5,000,000 ordinary folks warm all winter. It would keep 7,500,000 soldiers comfortable all winter in cantonments. It would send a fleet of twenty-five battleships across the Atlantic Ocean 3000 times!

If consumers can be aroused to an intelligent consideration of the problem, it is very easily within their power to save, without any discomfort or inconvenience, 10 per cent or more of the coal they have been accustomed to use. They should realize that one man's careless and wasteful use of coal may mean a cold house for his neighbor, and that a few such careless householders may mean an idle factory.

The problem is personal. It deals with the human element. The man whom the Fuel Administration is trying to reach is the man with the shovel. He is the great big factor in the present coal problem. Mainly, upon him, and his willingness to save, must depend the success of the present movement for fuel economy.

In American households there are 15,000,000 coal-shovelers, men and women. When they feed coal to their furnaces and kitchen stoves, they do not realize that it is the very life-blood of the nation that is going into those hungry receptacles. To waste any coal, under present circumstances, is nothing short of criminal.

One-fifth of our total output of coal is used for domestic purposes. Three-fifths are consumed by the railroads and power-plants of the country. Here again comes in the man with the shovel, 250,000 strong.

The Fuel Administration is carrying on an active campaign of technical instruction in the industrial plants of the country. Experienced engineers give instruction in the most economical and efficient firing of furnaces.

As for the householder, he must realize that it is worth while to examine his dwelling and overhaul his heating equipment. Weather-strips, double windows, pipe-coverings, clean flues and chimneys, and tight fittings in furnace parts will all pay. When you save electricity and gas you save coal. Turn out all lights when they are not needed. Use gas sparingly. Clean heating surfaces are most essential.

Soot is even a poorer conductor of heat than is asbestos.

Coal should be used sparingly in open fireplaces. Most of the heat goes up the chimney.

Don't let the house get too warm. It is uncomfortable, bad for health, and it means waste of fuel.

Don't bother with chemical "fuel-savers." They are humbugs.

Keep the rooms below 68 degrees. Most American houses are overheated.

Oil stoves and fireless cookers are recommended by the Fuel Administration as coal-savers.

Let the heat from the kitchen stove remove the chill from the air of the house as long as it will serve.

Reduce the hours of running the kitchen range as much as possible.

Be sure that the smoke-passages in the range are clean. Then keep them clean. If the scraper made for the purpose is lost, get another.

When the range must be run for several hours, a full firebox, carefully controlled by dampers, is more economical than a small fire.

With a big fire, a little air is needed over the coals, as well as through them.

When the fire is carried over night, fill the firebox with coal, cover it over tightly with ashes, and close all dampers. To start the fire, open the dampers below the grate and in the stovepipe. Break up the coke in the firebox, rattling the ashes into the ash-box.

Save as much coal as you can from the ashes, and use it when there is a good fire.

When the fire is well started, close the damper in the smoke-pipe as far as may be practicable with maintenance of the fire needed. When putting in fresh coal, open this damper, to prevent smoking.

Damper control is the secret of economical heating.

By observing these simple rules much coal may be saved. Now for the furnace:

Keep the ashes cleaned from under the grate. The fire will burn more uniformly, and with less clinker, with a clean ash-pit.

It is best to keep a full fire-pot, level with the firing door.

Keep the fire clean of ashes, else it will not be efficient for heating.

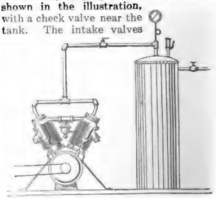
Attend to the furnace regularly. Anticipate the demand for heat. Rapid pushing or retarding of the fire is uneconomical.

Small charges of coal frequently applied are more economical than frequent firing. But the fire-bed should be disturbed as little as possible by shaking or poking. Shaking and clearing the grate twice a day is usually enough.

The United States Fuel Administration and the Bureau of Mines are ready at all times to aid with practical instructions and advice those who are striving to cut their own coal bills and save fuel for the nation.

A Motorcycle Engine used as an Air Pump

A VERY good air pump may be made from an old motorcycle engine of either a single or twin cylinder type. All that is required besides the engine is a few valves, some pipe fittings and a tank strong enough to stand 100 lb. pressure. The exhaust-valve lifts must be removed so that the valves will remain closed all the time, and must be ground in with emery and oil to a good fit to prevent any leaks. The connections are made from the spark-plug holes to the tank as shown in the illustration, with a check valve near the tank. The intake valves



A motorcycle engine mounted on a block of wood. It is used for an air compressor

must be altered, as they work at each stroke of the piston to let in the air. A 30-gal. tank, tested to 200 lb., is used with the safety valve set at 100 lb. The pump will supply a large amount of air if run at 200 r. p. m. and will not heat up to a great extent. — J. W. WOODMAN.

A Block of Wood for Holding the Clothes Line Taut

A CLOTHES line holder that will grip the line tighter as the weight is increased can be made in a few minutes out of two large screweyes, a 2-in. carriage-bolt and a piece of hard wood about 6 in. long, 2 in. wide and ¾ in. thick, cut as shown.

Cam-shaped block to hold clothes line

First, drill a hole that the carriage-bolt will easily pass through in one corner, about 1 in. from the end and ½ in. from the side. Now round off the corners to the shape shown in the sketch. Next, screw the screweyes into the clothes-post far enough apart so that the wooden block will easily pass between them, as shown. They should be screwed in until the centers of the eyes are about 1½ in. from the post. Then place the wooden block between them. Line up the hole with the screweyes and insert the bolt.

To use the holder, lift the end and drop the clothes line in the space between the screweyes. Pull down the end again and it will wedge itself against the clothes line with a grip that will tighten as the load grows.—FRANK L. MATTER.

Making a Barometer from a Burned-Out Electric Globe

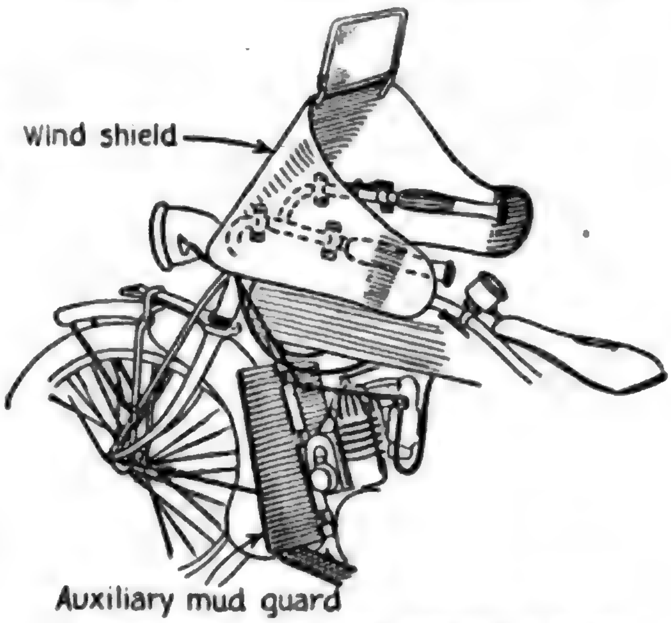
A BAROMETER, which will prophesy weather conditions a day in advance, may be made from an ordinary incandescent bulb. Select a 60-watt lamp. One that has burned out will do. Hold it under water and file off the glass tip at the end of the bulb. The vacuum will cause the water to enter through the hole thus made, filling the bulb completely. The barometer should then be suspended with bulb end downward.

When a drop of water appears suspended at the outlet, you may look for a storm to-morrow; when the drop disappears, fair weather is in store. There is a perfectly natural reason for this phenomenon. Stormy weather is always preceded by low barometric pressure. The atmospheric pressure having decreased, the weight of the water inside the bulb tends to force water through the outlet. This force is small, but it is sufficient to allow a drop of water to escape and hang suspended from the tip of the bulb. On the other hand, fair weather follows an area of high barometric pressure. The pressure of the atmosphere, under such conditions, will prevent the water from escaping and the suspended drop will be forced back into the bulb.

This simple barometer may be screwed into a wall or ceiling lighting fixture, which is out of service.—K. M. COGGESHALL.

How to Make a Windshield for the Motorcycle Messenger

THIS windshield is made of sheet metal bent to conform to the shape of the handlebar. As shown, three fastenings are used, but more may be applied if desired. One is at the head and the other two are about half way between the grips and the head. It is topped with an isinglass protector, fastened as illustrated. There is a flare of each grip to make room for the hands, and to shelter them from the wind and rain.



Sheet metal, shaped and attached to the handlebars to serve as a wind shield

The mudguard is also made of sheet metal. It consists of two wings bolted to the frame so that the front guard will clear, the footboards having just room to fold up.—GEO. STENCHAM.

How to Make a Strong Glue That Will Withstand Moisture

A GLUE that is waterproof, is very useful to have around the house for various repair jobs, as well as for new work in the amateur experimenter's shop. Waterproof glue is superior to the ordinary kind, as it resists dampness and is richer in adhesive properties. The formula is as follows: Soak ordinary glue in water until it swells up, but does not lose its shape. When it is thus softened, drain the superfluous water from it and transfer it to a glue pot. Add an equal quantity of linseed oil and boil the mixture over a slow fire until a jelly-like mass results. It is then ready for use. Such glue will join various materials in the most satisfactory manner. It holds remarkably well, dries quickly and resists moisture. It can be depended upon in every respect.

Another Card Trick—the Inseparable Jacks and King

THE feature of this trick is that three jacks and a king are withdrawn from the pack which is shuffled. Then the four cards are placed in various parts of the pack and the pack is cut. When examined it will be found that the three jacks and the king have rejoined one another and are now all together in the center of the pack.

Begin by taking out the three jacks and one king, and, while looking over the pack for these cards, contrive to slip the fourth jack to the bottom of the pack. Give a false shuffle, leaving the fourth jack at the bottom of the pack. Now, proceed to place the four cards in various parts of the pack as follows: Place one of the jacks at the bottom of the pack, one at the top, and one in the center at any point. Place the king on top of the pack. By this arrangement of the cards there will be two jacks on the bottom of the pack and one king and a jack on the top. It is obvious that if the pack is cut, all four of the cards, the three jacks and the king, will be brought together in the center of the pack.

The jacks finally shown are not the ones originally selected, the one placed in the center of the pack is lost, and its place taken by the jack secretly placed at the bottom of the pack prior to the commencement of the trick. It is very seldom that this fact is noticed by the audience.

Making Simple Life Slides for Microscopic Work

THE practical pond microscopist quickly discovers that the glittering brass and glass paraphernalia supplied by the optician are not only unnecessarily expensive but often by no means well adapted to his requirements. The several devices herein described can be made easily and will be found to serve a variety of purposes.

For low power work, where an objective that will work through an ordinary 3 by 1-in. slip is used, the slip described herewith,

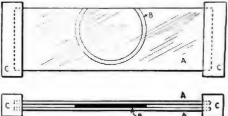


FIG. 1

Two strips of glass with rubber ring between, held together with wooden pieces

will be helpful. Two 3 by 1-in. glass strips are used, shown at *A* in Fig. 1. Inclosed between them is a rubber ring *B* from which a piece has been snipped with a pair of scissors. A piece of hard wood *C* is slipped over each end. In this, a groove is cut the requisite width to hold the glass pieces together. Put just sufficient pressure on the rubber to prevent leakage of water. Two or three such slides can be made, using rings of different thicknesses.

An exceedingly simple life chamber, but one that is useful for many purposes, is made

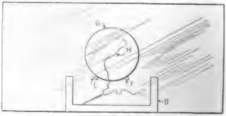


FIG. 2

A reservoir slide to hold nutritive fluid that is convenient for examining algae

by turning a ring of paraffin wax on the object slide; covering it with a thin glass. Two or three very small threads should be

placed in the center of the ring. The object of the threads is to prevent the drop of water running around the sides of the cell.

A reservoir slide, Fig. 2, is sometimes convenient, particularly for the examination of algae, as it provides a relatively large volume of nutritive fluid. A useful trough can be made on a 3 by 1½-in. slip in the following manner: Cut a piece of flat and parallel-sided hard rubber to the shape shown at *D*, so as to make a trough about 1¼ by ½ by ¼-in., and cement this to the slip midway between the ends and flush with the sides. Cover this with an oblong cover glass or a piece cut from an object slide, cemented on water tight. Two small pieces of glass, *E* and *F*, should be cemented to the slip to form ledges on which a circular cover glass, *G*, can rest without risk of its slipping down into the trough. A filament of growing algae, *H*, is shown ready for examination, having been passed up from the trough in which it was growing, and covered with the thin cover glass.

In Fig. 3 is shown another useful though very simple device. It consists merely of a 3 by 1-in. slip, around which two pieces of silk or cotton threads, *I* and *J*, are tied a short distance apart, the covered glass, *K*, being laid across them. This forms a shallow cell which is open to the air almost all around. The water can be renewed as it evaporates by adding a drop to the edge

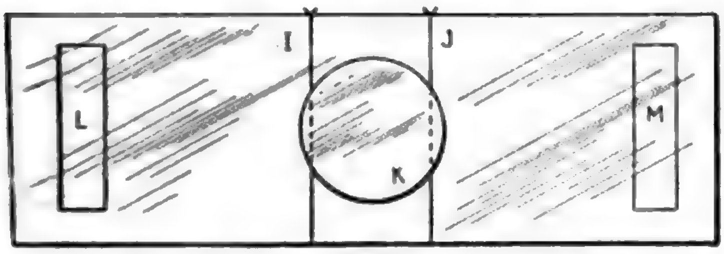


FIG.3

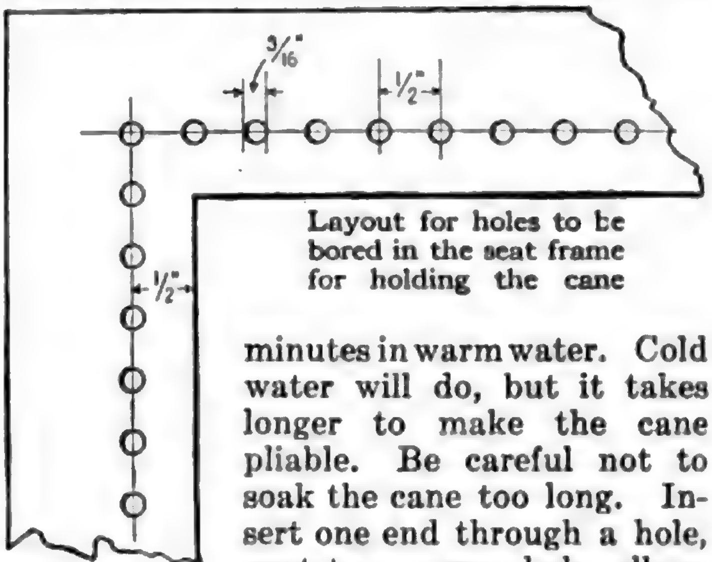
A slide that provides a way to renew the water by adding a drop to the edge

without disturbing either the object or the glass. The drop will be sucked up by capillary attraction. Areation of the water is thus facilitated.

In order to make the slide rest firmly on the stage, stick small pieces of paper, *L* and *M*, to the underside, one at each end. Several slips may be prepared, using different thicknesses of thread. These may be numbered in accordance with the depth of the cell. The numbers should be written on one of the paper strips so that they may be read through the glass.—H. J. Gray.

Cane Chair Seats and How to Weave Them

There are seven steps in the weaving of the cane for a chair bottom, or other paneled work. These are described and illustrated in a new book, entitled *Seat Weaving*, by L. Day Perry (Manual Arts Press). First of all, the cane must be soaked for a few



Layout for holes to be bored in the seat frame for holding the cane

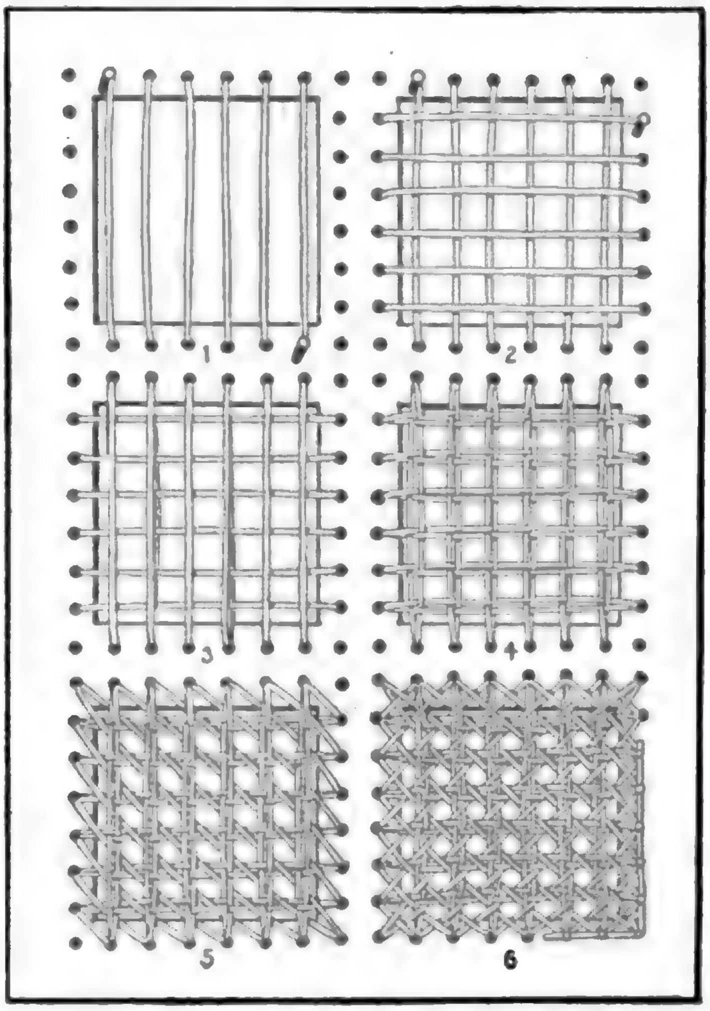
minutes in warm water. Cold water will do, but it takes longer to make the cane pliable. Be careful not to soak the cane too long. Insert one end through a hole, next to a corner hole, allowing it to project about 3 in. below, and fasten it by driving a peg in the remaining part of the hole. Pull the entire strand through between the thumb and forefinger to prevent its twisting, and run the other end down through the opposite hole, next to the corner hole. Make sure that the smooth side of the cane is out on the underside of the frame as well as on top. In doing this, the cane is pulled reasonably taut, then fastened in the latter hole with a peg to prevent its slipping back and becoming loose. Draw the cane through between the thumb and forefinger again, pull it over to the next hole, or second one from the corner, and run the end up through and across the top, parallel to the first strand, and down through the opposite hole in the other piece, or second hole from the corner, and fasten with a peg. This operation is repeated until all holes have been utilized on the two parallel rails, except those at the corners. Throughout the seven operations, the cane must be kept from twisting by drawing it between the thumb and forefinger. With this first step completed, all holes in the two rails opposite will be entered, with all cane running parallel ar on the upper side, the cane crossing fr hole to hole on the underside.

The second step is just the same as th first; the only difference is that the other two rails of the frame are used and that the

cane runs over the first set of parallel cane. If the first strand of cane has not been used up in the operation, the remainder is used to begin the second step.

The third step is a repetition of the first two. The cane of the series runs over the first and second series and parallel with the first. As each strand is used up, bind the end by pulling it under a cane, crossing from one hole to another underneath the frame. Then cut it off about ¼ in. from the cane. This binding is clearly illustrated. The loose end at the starting point is tied in the same manner, and all other ends should be tied as soon as the strand is used up. Thus the use of many pegs is avoided and a neat binding is assured.

The actual weaving begins with the fourth step. This may be done entirely by hand, but it is slow work. A needle should be used. Start at a hole next to a corner one on either rail that has been used but once, working from the caned side toward the open frame. Pass over and and under the strands necessary to form the weave, turning the needle from side to side in order to catch the canes back of the point. When across, thread the needle with the strand and pull it through, being careful to avoid a twist. Pull the end down through the hole, pairing the canes. Pull the cane up through the next hole and start the needle from the opposite side of the frame. Repeat the first operation, thus pairing another set of canes. Continue this operation until all the canes are paired and all holes used. Soak the woven cane with a wet sponge, and with two pegs straighten the strands of cane and force all pairs together. Small open pairs are thus formed over the area being caned. Unless the cane is soaked very thoroughly, it will prove rather difficult to pair the canes.



Successive steps in placing the cane in the holes for making a bottom in a chair

The fifth step is the weaving of one set of diagonals. Start the strand at any corner hole. Use one hand over and one under the frame. As the worker becomes more skillful, he find it easier to give the cane a slight curve and work with both hands on the upper surface. Use an end of cane long enough for convenient handling, then pull the entire strand through the length of the frame, provided the area is not too great. Care must be taken to avoid twisting the cane. The cane runs very easily and partially under a cane at the corners of the squares, if the weaving is correctly done. This is plainly shown in the illustration. All the corners bind and the strand pulls with great difficulty if the cane is incorrectly woven. On parallel canes see that the canes run either over or under the pairs.

The sixth step is just the same as the fifth, the canes running at right angles to the first diagonals. In this step and the preceding one, note that two strands run into the corner holes. This holds true in all rectangular frames where a corner hole is bored. It permits the strands to run in as straight a line as possible. If it is necessary to turn abruptly to enter a hole it is obvious that an error has been made by the weaver.

In the seventh step a cane of the same size as that used for all the work is pulled up through a hole, over the binder-cane and down through the same hole. A loop is thus formed and the binder secured. Pull taut, then enter the next hole, pull up the cane over the binder, then down, and so on. This operation may be repeated at every other hole, when the holes are close together. The two ends of the binder are finally overlapped and carefully secured.

A RIFLE RANGE

By Geo. M. Petersen

IN these times, when efficiency for military service is the principal requirement of men, it is well for everyone to understand thoroughly the handling of firearms and how to use them most effectively. Not only is such knowledge a protection, but the Government gives increased pay to those men who can qualify as sharpshooters or experts.

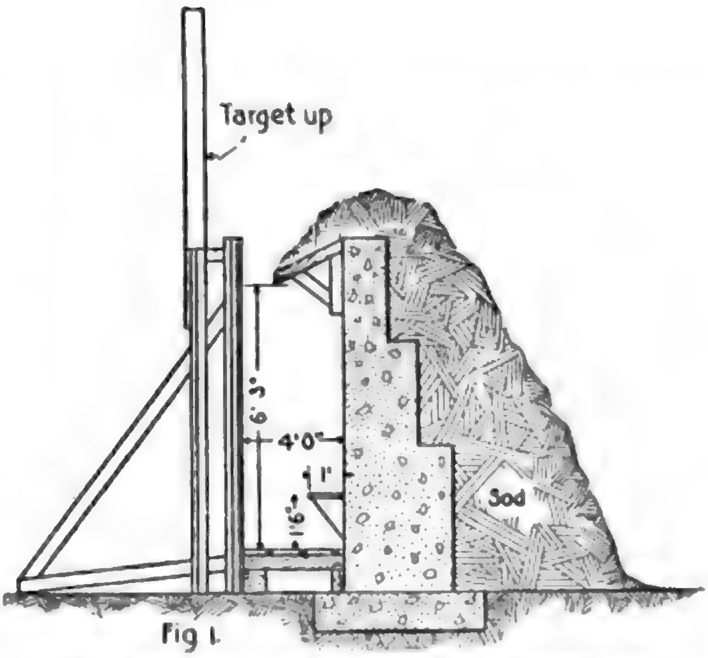
Of course there are numerous exercises which may be practiced to good advantage, but there is nothing which will perfect your shooting like real firing on a range.

Even as a mere pastime, shooting is beneficial, as it trains the eye, the hand and the entire nervous system so that they may be kept under absolute control. A rifle range can be laid out and built anywhere where there is space enough to get the different ranges or positions desired and to care for the bullets after they pass through the target.

The most common methods of constructing the pits or "butts," as they are termed, are shown in Fig. 1 and Fig. 2, the latter type being the most generally used. The type shown in Fig. 3 is for pistol and small-caliber rifles only, and should never be used for high-power sporting or military rifle work as there is a possibility of the bullets passing through the wooden retaining wall and injuring someone.

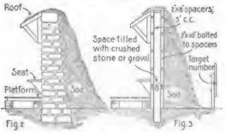
The best ground for a rifle range is smooth and level or it has only a moderate slope. The targets should preferably be on the same level as the firer or slightly above him. Firing downhill should be avoided. The light should also be considered when laying out a range. If possible, the firing should be toward the north or slightly east of north so that a good light will be on the targets during the greater part of the day. Security and suitable ground are much more important than direction of light, however, so that naturally they must be considered first.

As high-power sporting and army rifles have a range of from two to three miles, it is imperative that an effective bullet stop be provided behind the targets to prevent the bullets passing through the targets and killing or injuring someone in the far distance. Where the butts are situated on the bank of a large body of water, so that the bullets will drop into the water without doing any harm on the way, it is only necessary to have a lookout stationed at one side of the butts and high enough so that he may observe the entire field of fire with the aid of field glasses. This lookout is responsible for stopping the firing when a boat is passing within range of the rifle fire. He accomplishes this by lowering a large red flag to half mast. As soon as the person in charge



One of the common methods of constructing a pit or butt, behind which is the target

of the butts sees the flag go down, he immediately orders his target half masted and the red flags placed on each one until the lookout runs his big flag up to the top of the mast, signifying that the coast is clear. However, when this method cannot be used,



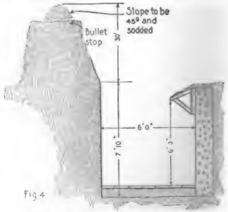
One of the most popular pits. Also a target pit for pistol or small caliber rifles

a bullet stop, similar to the one shown in Fig. 3, should be built.

This stop should be about 30 ft. in height, with a slope of about 45 deg. and should be built up of earth, logs, wood and similar soft materials which will not cause the bullets to ricochet. The face of the stop should be covered with sod and it should be free from stones. A natural hill can sometimes be used for this purpose, by cutting steps into its face and grading the space between these steps to the 45 deg. When a natural hill is used as a stop, the pit may be sunk down so that the appearance of the completed butts is similar to that shown in Fig. 4. In any event, the bullet stop should extend from five to ten yards beyond the last target at either end of the butts.

In Fig. 1 we have a concrete retaining wall over which the earth is piled, tamped and covered with sod. This type is desirable where stone is scarce or transportation difficult, although the stone wall shown in Fig. 2 seems to be the most popular, when the material can be readily obtained. As mentioned before, the wall shown in Fig. 3 is used only for pistol or small-caliber rifle work, as it would hardly afford protection enough against bullets fired from a high powered army or sporting rifle. In this type of wall, 2 by 8-in. planks are stood on end, 3 to 4 ft. from center to center, and 2-inch planks are bolted to them on each edge. This leaves an air space between the two walls which may be filled with crushed stone or coarse gravel. The earth should be piled at least 2 ft. deep over this type of wall so as to remove any chance of a bullet ploughing through it, even though someone should inadvertently fire a high power bullet into it. The cost of this type of wall would nearly equal that of concrete wall so it will be seen that it would be foolish to use this wooden wall except when the cost of transporting cement, gravel or stone would be much above normal. In Fig. 4 is shown the submerged type of pit. When drainage facilities are available, this is a good type, although a pit which is half way between Fig. 2 and Fig. 4, that is, a pit which is half excavated and half built up, is, to my mind, the best and most satisfactory as well as the cheapest in the long run.

In Fig. 5 is shown the details of the roof construction. This roof is covered with earth and sod. It is not absolutely necessary to cover the boards, as the only duty devolving upon them is to prevent the dust, dirt and small stones from falling on the men in the pits when a low shot knocks the top off the parapet. The sod does improve the appearance, however, and for that reason it is generally used on club ranges. In Fig. 6 is shown the platform construction, which consists merely of 4 by 6-in. sleepers, on which are placed 2 by 10-in. planks about



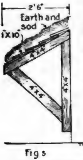
Where a natural hill is used for a stop, a pit for the signal man is dug in front

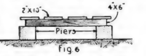
3 in. apart. These platforms should be placed well above the bottom of the pit so that the sun and wind may get underneath them and keep the bottom of the pit dry and sweet.

The length of the butts are naturally governed by the number of targets it is de-

sired to mount, each full-sized target requiring about 10 ft. of space—7 ft. for the target and 3 ft. for a walk between the targets, to make it easy to handle the rear targets. A range may have from one to sixty targets, although the largest one I ever had the opportunity of shooting over had only thirty.

The targets themselves may vary in size, depending upon what kind of rifles are to be used, and the distance between them and the shooters. The illustration, Fig. 7, gives the dimensions





Details of the roof. Also platform for the men who are watching the target to stand on

of the army targets for various ranges and kinds of fire. These dimensions may be used as a basis upon which to determine the size target most desirable for the particular work in hand. A pistol target is shown in Fig. 8.

The "standards" for the targets are made as shown in Fig. 9, the rear end being weighted down by putting a plank across the

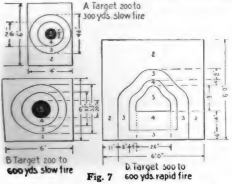


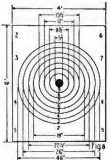
Fig. 7

Sizes of targets for various ranges and kinds of fire which may be used as a base

two braces and loading it down with stones or other heavy materials to help keep it rigid and straight. The "carriers" for the targets are shown in Fig. 10, two carriers and two targets being provided for each standard, the targets so counterbalancing each other as to greatly facilitate handling and working.

Target frames are made as shown in Fig. 11, the space marked "A" being covered with light-weight canvas or heavy unbleached cotton. On these the paper targets are pasted. The complete "target" consists of one standard, two carriers and two target frames as shown in the assembled drawing in Fig. 12, the targets in the drawing being half masted, *i. e.*, one behind the other.

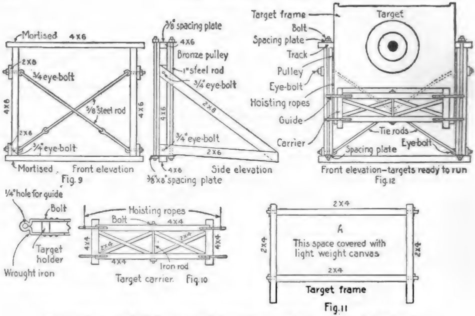
In Fig. 13 is shown the marking disks. These disks are secured to long poles, one disk at each end, each side of each disk being marked differently. For example: For a shot in the center of the target, commonly called a "bulls-eye," the white disk, having a value of 5, is shown. If the shot was in the 4 ring, the red disk is shown; the 3 ring requires a black and white disk, and a shot in the 2 ring calls for a black disk. A "miss" is recorded by slowly moving a red flag across the face of the target, while a ricochet hit (one which hits the target after striking some other object) is shown by moving the ricochet flag up and down in the center of the target.



Dimensions for a target to be used for pistol practice

When a shot is "called," it is given its value and its "o'clock," the target being considered a clock laid out as shown in Fig. 14. The first shot recorded is called an "eleven o'clock three" or "a three at eleven o'clock." This indicates to the firer that he is shooting high and to the left of the bull. The second shot shown is a "four at six o'clock" which means a correct alinement but a little low. The third shot is a "two at one o'clock" showing that the aim was to the right. After a little practice the "o'clock" becomes natural to you and you think of all of your shots in this manner.

After each shot is fired, when firing the slow fire course, the targets are pulled down, the hole pasted up, the target run up and the shot marked by means of the code given above, care being exercised to get the right side of the marking disks out. By locating the shots correctly on the target, the firer can



Framework or standard for two carriers and two targets, one counterbalancing the other. The targets are pasted on a canvas stretched over the sliding frames

eventually get the zero of his rifle, or learn just where he must hold his pistol in order to do good shooting.

Pistol targets are marked differently than rifle targets because of the different rings and values on the target. Only the red and white disks are used, the white for the bull or

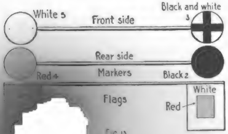


Fig. 13

mounted on poles, to signal the location of the shot

or all others. The red disk ver the shot hole and then til it blocks out the large edge of the target which represents the value of the shot. For instance, if a shot was through the seven ring, the red disk would first be placed over the shot hole and then moved over until it covered the seven on the side of the target.

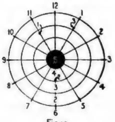


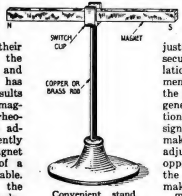
Fig. 14

With the aid of the information given herein, it should be possible for every little club or town to have a rifle range where the men and women, and boys and girls may have an opportunity to learn to use firearms in the proper way, so that they will become a blessing in an emergency. A thorough knowledge of firearms would also decrease the number of accidents with them, most of which are due to lack of understanding. With a little practice in using a firearm, the most timid need not be afraid to use one in cases of emergency, and will in many instances grow to enjoy target shooting for its own sake.

The Amateur Electrician And Wireless Operator

Use of a Permanent Magnet with the Audion

MANY articles have been published in electrical publications regarding the use of permanent magnets in connection with vacuum tube detectors. Some authors state that the intensity of signals is greatly increased, by the use of magnets, while others find that no advantage is gained by their use. Experiments with the various types of magnets and several makes of tubes, has shown that while good results may be had without the magnet, providing a filament rheostat with a very delicate adjustment is used and patiently adjusted, the permanent magnet is an accessory worthy of a place upon the operating table. Because the output of the filament battery varies gradually, especially if a small storage battery is used, readjustment of the rheostat is necessary from time to time. The best adjustment of some tubes is so critical that it can seldom be reached with the standard battery rheostat.



Convenient stand to support magnet in various positions

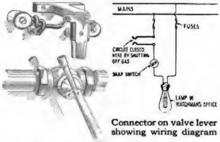
If the rheostat adjustment is left slightly below the critical best point and a permanent magnet (a bar magnet is best) upon a suitable stand is moved toward the tube, the electron discharge will be varied by the influence of the magnetism, and a point will be reached where the signal intensity of certain stations is loudest. A further movement of the magnet toward the tube will cause a reduction in signal intensity, and sometimes the rheostat adjustment may be such that a second position of stronger intensity may be found with the magnet very close to the tube. The position of the magnet in the second field must be more precise than in the first field. It seldom permits more than 1/16 in. variation. The polarity of the magnet will also be found to make a difference, one pole bringing in louder signals than the other pole, regardless of their positions. Interference may often be reduced by the use of the magnet in the first sensitive field, and the adjustment is far better than that secured by the finest manipulation of the receiving instruments. A slight movement of the magnet within this field will generally cause one of two stations, having about the same signal intensity, to fade, thus making the other readable. An adjustment of the magnet in the opposite direction may cause the other station to fade and make the first readable.

The magnet seems to have a different effect upon some stations, which though quite loud and readable with the magnet in one of the fields, will come in still more strongly when the magnet is withdrawn from the tube.

A convenient stand for supporting the bar magnet in various positions is shown in the illustration. The base of the instrument should be cast and turned out of babbitt metal, and may be nickel or silver plated. A hole is drilled and tapped to receive the threaded end of a brass or copper rod, of a length depending upon the height of the detector from the table. A switch-blade clip removed from an old switch, or its equivalent made from spring brass, is soldered to the upper end of the rod and is used to hold a small permanent bar magnet as shown.—H. W. OFFINS.

Signal Light to Show Gas Turned Off at Oven

A SMALL manufacturing concern which uses a gas heated enameling oven, found that considerable gas was wasted because the workmen frequently forgot



Connector on valve lever showing wiring diagram

to shut off the gas when quitting their work for the night. As a result, the oven burner would be left on all night, with the consequent waste of gas and the liability of overheating and setting fire to the building or of doing damage to the oven and its contents.

To prevent this, the shut off valve on the gas line was provided with an insulated extension on the valve handle, as shown in the illustration. Over the end of this insulated extension is placed a metal ferrule which closes the contact between the two metal contact pieces attached to the two wires when the gas is shut off. These two wires form one side of the circuit for the lamp located in the night watchman's office, so that the gas must be shut off before the lamp can be lit. Should the gas be left turned on after working hours, the watchman is aware of the fact as soon as he comes on duty, as he can only secure light in his office when the gas is shut off from the oven burner. The diagram in the illustration shows the wiring scheme in which a snap switch is used to turn off light after the signal shows that the valve has been closed.

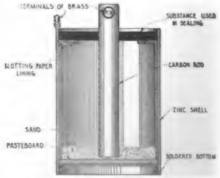
This signal, while especially built for this purpose, is only suggestive and may be used in many like places as a safety device that will always signal when a certain necessary piece of work must be done on a set time, which may otherwise be forgotten by a careless operator or watchman.—PAUL JUSTICE.

Constructing a Dry Cell Which Can Be Renewed

PROCURE 1 lb. of chloride of zinc crystals, and dissolve them in about 1 quart of distilled water. Stir, until all the crystals pass into solution, adding more water if necessary. After all the crystals have dissolved, pour the solution into a clean vessel, and add enough distilled water to make up 2 quarts. Add 1 lb. of sal ammoniac to the solution, and stir it until the crystals have dissolved. Have a vessel ready to receive the contents. Then the prepared solution can be set aside for future use, after the vessel has been labeled "battery solution."

The cell is constructed, as shown in the accompanying illustration, from a zinc-lined can and blotting paper. Moisten the blotting-paper lining with the battery solution, and pour off all excess liquid. Permit the blotting paper to become almost dry. Mix finely powdered manganese and carbon with a small quantity of the battery solution until it has acquired the consistency of a stiff paste. Put the carbon center post in the can, after having covered the bottom of the can with a layer of sand about ¾-in. thick.

The can is then ready to receive

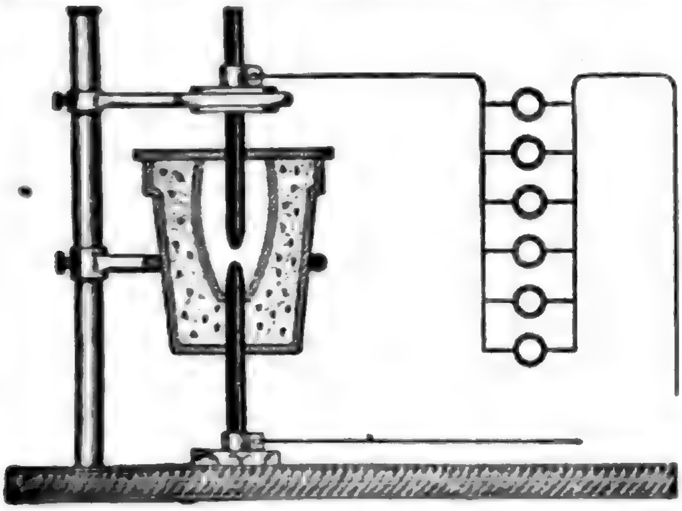


Sectional view of dry cell in which the contents may be removed and renewed

the paste, which should be packed down hard with an improvised ram. The top of the cell should be sealed with paraffin, or a similar substance that can be removed easily, in order that the cell may be renewed at any time with little or no trouble.—HERMAN NEUHAUS.

How to Make an Electric Laboratory Furnace

IN the laboratory, it is often desirable to secure heat greater than that produced by the Bunsen burner, or even a greater range of temperature than can be reached by the Scimatco burner. This makes the use of an electric furnace necessary. A furnace that can be constructed by any amateur is herein described. It is very convenient to handle, and the materials that are utilized in it, can for the most part be found in the laboratory. The terrific heat generated by this furnace is capable of reducing alumina. Its other uses are familiar to all those who work in the laboratory.



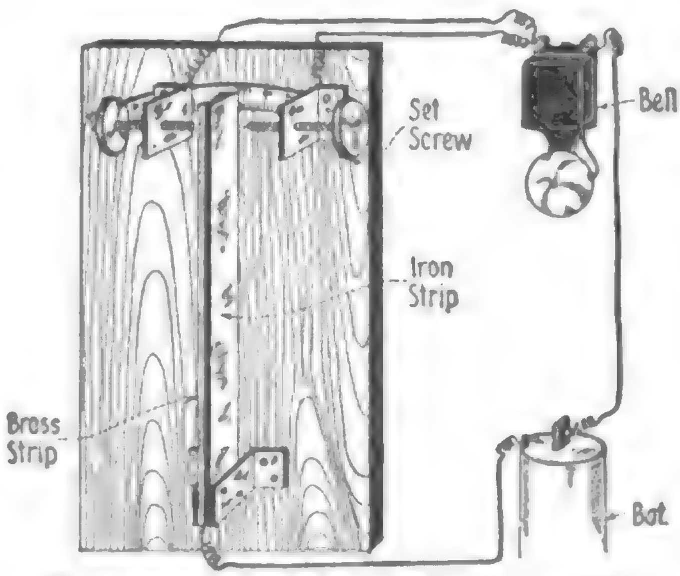
Flower pot suspended on a ring stand and holding crucible to melt metals electrically

As can be ascertained in the accompanying illustration, one of the most essential parts of the apparatus is the two-ring stand which serves as a support for the main part of the furnace. The rings support a flower pot, in which is placed a small crucible, made either of porcelain or alundum, according to the work that is to be done by the electric furnace. The crucible should be placed in the flower pot in such a manner that it may be readily removable when necessity arises. The space between the flower pot and the crucible is filled with pulverized fire-brick, but if that cannot be obtained, the fire-brick may be of the ordinary granulated variety. A sheet of thick mica covers the top of the furnace, and a hole is bored in it to permit the passage of the carbon. This carbon is supported by the upper ring which has been provided with an asbestos plug to hold the carbon stationary. A brass ring prevents the carbon from slipping, and forms a means of regulating the distance between the carbons. The other carbon goes through the bottom of the flower pot, and through the crucible, which has previously had a hole that fits the carbon snugly drilled in its bottom. The lower carbon rests upon a block of wood or asbestos which is placed on the base of the stand. The terminals of the furnace are shown in the illustration. To secure best results, the lead-in wires should be of No. 14 copper wire.

The furnace requires from six to eight ampere of current, using a direct or alternating current of 110 volts connected with incandescent lamps as shown, or with a water rheostat. At first, it is advisable to operate the furnace empty, in order to ascertain whether the apparatus stands up well under the terrific heat generated. It is also strongly advised that the operator use smoked glasses when the furnace is in play, as the glare produced has an unpleasant effect on the eyes.—HERMAN NEUHAUS.

Thermostat Made from a Brass and an Iron Strip

IRON and brass expand to different lengths at the same temperature and for this reason these metals are ideal for



The two metals riveted together and mounted on a base to operate an electrical system

making a thermostat. I took a piece of iron 12 in. long, ¼ in. wide, and 1/16 in. thick and riveted it to a similarly shaped strip of brass. This compound strip I

fastened by its lower end in a vertical position to a wooden base 10 by 16 in. Near the upper end of the strip, and on either side, I mounted setscrews.

The distance between the upper end of the compound strip and the setscrews can thus be regulated as desired. The lower end of the strip, I wired to a battery and bell, then from both setscrews to the bell as shown. By this means, the bell is rung when the room becomes too warm or too cool. In either case, the circuit is made by the compound strip bending until it comes in contact with the setscrew. The dotted line shows the thermostat bent to the right because the heat in the room has expanded the brass faster than it did the iron. This rings the bell.

In the same way, when the brass contracts faster than iron, the strip is bent to the left.

The distance between the setscrew end and the strip can be regulated so that the bell rings at any desired temperature. A scale can be marked upon the wood back of the upper end of the strip, for convenience. This will vary for every thermostat made and should be determined by using a thermometer. When the bell rings, I look at the thermostat to see whether fires need starting up or shutting off. The bell is easily silenced by slipping a piece of rubber between setscrew and strip. This breaks the circuit and the rubber falls as soon as temperature approaches normal and the strip comes back to its perpendicular position. When the iron strip is riveted to the brass, the two metals should be kept in the normal temperature, say at a temperature of 65 deg. for an hour before fastening them together. In this way the compound strip will always be perpendicular when the room is at about the right temperature.—F. E. Brimmer.

Finding the Polarity of Electric Wires with a Potato

THE amateur electrical experimenter often finds it necessary to know which wire is the positive wire for making proper connections to his apparatus.

The positive pole of a wire or of an electric battery can very easily be found by means of an ordinary potato. Cut the potato in half, lengthwise. For a low direct current voltage of 1½ volts to 10 volts, place the wires to be tested a short distance apart in the potato.

The positive pole part of the potato will turn green, while the negative one will remain colorless. This method can be used to find the polarity of one dry cell and upwards to 500 volts direct current; the only difference in using the higher voltage being that the wires require to be further apart. In using the 110 volts pressure, the time necessary to determine the polarity is about 10 seconds. With a current of say 2 volts and upward to 10 volts, it will require about one minute. If electrical workers will always carry a potato in their tool bag, they will have a reliable polarity indicator. The method cannot be used on alternating currents, as both ends of the wires would turn the potato green.—W. S. Standiford.

A Spark Plug Tester with an Inclosed Spark Gap

A VERY simple and convenient tester for spark plugs on automobiles, motor boats, motorcycles, etc., is shown in the accompanying illustration. The body of the tester is of hard rubber in which is imbedded the metal contacts, and the spark gap is protected by glass discs. The nature of engine trouble can be quickly diagnosed by application of this tester. It shows at a glance, what otherwise might require an overhauling of the engine to discover.

A spark gap is inclosed in the hard rubber tester

A regular spark shows a good plug. A non-spark shows a short circuit. An irregular spark shows defective porcelain. A clear spark shows that the trouble is in the mixture and indicates no power. A knock in the motor will be magnified, and the cylinder in which it occurs can be located.—Floyd L. Darrow.

Electrical Devices and How They Work

Secondary Cells; Storage Batteries—II

Accumulators are cells of battery that will receive a charge of electricity and keep it stored until it is released through mains for power and light

By Peter J. M. Clute, B. E.

IN the primary cell, electric current is produced by the decomposition of the electrolytic solution and the consumption of a zinc electrode. In other words, the varying natural potentials of two substances, such as zinc and copper or zinc and carbon, constitute the original impulse to a succession of reactions whereby chemical energy is transformed into continuous electrical energy. On the other hand, in the secondary, or storage, battery, electric current is generated by a somewhat similar chemical reaction, originated, however, by chemical changes, produced by an electric current passed through the cell at the start of operations. This operation is termed the charging of the cell.

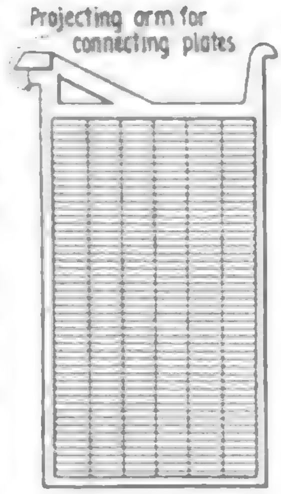


Fig 1

Positive lead grid of a storage cell

Such cells are called secondary cells because their action is dependent upon the effects of the energy impressed upon them by a primary electrical source. They are designated as storage batteries because, apparently, a quantity of electrical energy is stored in them in the form of current, to be delivered, also in the form of current, when the battery is connected as a source of electricity.

Storage cells of all descriptions are charged from D. C. service mains, or from special charging generators. The current may be regulated to the required rating by suitable resistance, usually through special switchboards, designed to meet the requirements of charging. If the only available current supply is alternating, it can be transformed into direct current by means of a rectifier, or a motor-generator set. The secondary cell is capable of being recharged after exhaustion by passing an electric current through it in a direction opposite to that of the current on discharge. This difference constitutes the principal advantage of the storage battery over the primary cell.

The typical storage cell is the lead-lead couple in an acid electrolyte. There are, however, other varieties of such cells, all of them more or less experimental in character. These may be designated as lead-copper, lead-zinc, alkaline-zincate, etc., all using corrosive electrolytes. In addition to these, and in a class by itself, is the Edison nickel-iron cell, using an alkaline and non-corrosive electrolyte.

The commercial storage cell consists of an even number of positive plates and an odd number of negative plates, immersed in a dilute electrolyte (generally sulfuric acid) contained in a jar or box of non-conducting material. The plates are arranged alternately positive and negative, and are cast with a projecting arm as shown in Fig. 1, so that all positives may be connected by a single stud, and all negatives similarly united—each such unit of several plates being one element of the cell. The positive terminal at which the charging current enters the cell, passing to all positive plates, and at which the current leaves the cell on discharge, is called the anode. Similarly, the negative

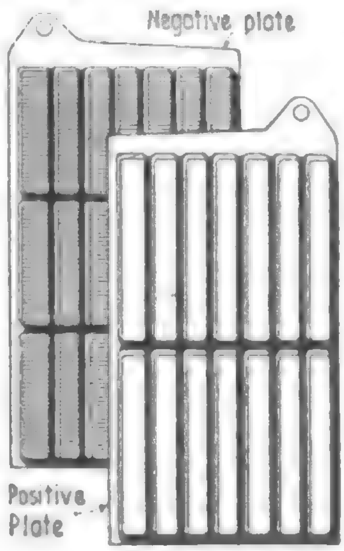


Fig 2

Positive plates of perforated steel tubes

terminal, at which the current emerges after passing through all the negative plates, during charging, and at which the current enters, on its return path on discharge, is called the cathode.

The conditions in operating a storage cell are most exacting, and serious complications are liable to follow violation of the rules. Thus, it must neither be charged nor discharged too quickly, there being safe average rates in both cases. It should never be over-charged or over-discharged beyond the safe limits prescribed. The voltage at full charge should not exceed 2.6 volts, and its working pressure not more than 2 volts. On normal discharge, it should not be permitted to fall below 1.75 volts. The discharge capacity of a storage cell (its current rate) is measured in ampere-hours, which are found by multiplying the current in amperes by the number of hours at which it can flow at not less than 1.75 volts. In order, however, to standardize, the normal discharge rate is assumed to be at 8 hours. In the main, the ampere-hour capacity decreases with increase in the current rate.

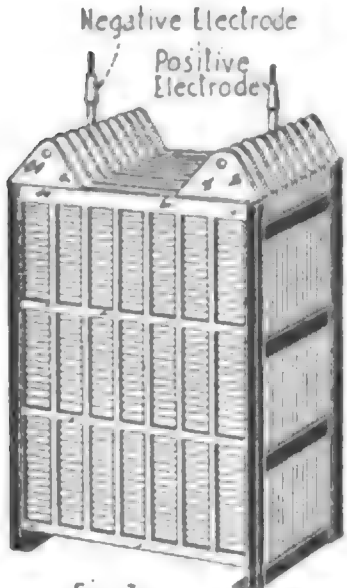


Fig. 3

Grouping of positive and negative plates

The ideal storage battery or accumulator is an electrolytic cell in which electrical energy may be stored as chemical energy until ready for use. It must be capable of returning at any time all, or any part, of the electrical energy put into it; and when discharged, the cell must be in its original condition. It is, therefore, necessary to find a perfectly reversible chemical reaction whose direction and energy relation is perfectly controlled by the electric current. That is, no chemical action should take place except that which necessarily accompanies the flow of useful current when on charge or discharge; and secondly, the quantity of material whose chemical composition is changed should be proportional to the quantity of electrical energy passed through the cell.

The nearness of the plates to each other and the large surface obtained by using a number of plates, cause the resistance of the cell to be very small. The greater the number and size of the plates in a cell, the larger the current that can be sent through it without injury to the cell.

The commercial importance of such storage cells is due in part to their extremely small resistance, and to the fact that they can be renewed not by means of costly chemicals, but by a current obtained from a dynamo, driven by engine or water-power.

Making a Wet Battery from Ordinary Dry Cells

WHEN a dry battery of an electric door became exhausted and there was no sal ammoniac on hand to renew it, it was decided to try in its stead some hyposulphate soda. After removing the cardboard wrappers from the cells, a number of perforations were made in the zinc casing, then the cells were placed into wide-mouthed fruit jars, into each of which was put several spoonfuls of the salt and enough water to fill them within 1 in. of the top. If the water should cover the cells, it will cause a short circuit.

Upon testing the battery, while the cells were still in the jars, it was discovered to be fully as powerful as one composed of new dry cells. Then the experiment was tried of using it just as it was—a new type of wet battery. It has proved so effective that after a year of use it has required no other attention than that of replacing the water evaporated. Thus, at no expense, excellent results have been obtained, and the cost of several dry cells saved.—F. M. WAGNER.

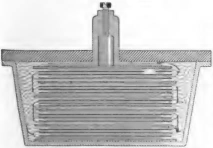
Coating a Tin Oil Can to Prevent Rust

A COMMON tin oil can may be made rust proof if it is given a coat or two of paint, especially on the bottom. It is worth while, occasionally when through painting, to wipe off the paint brush on the bottom of the old oil can, just before the brush is laid away.—JAMES M. KANE.

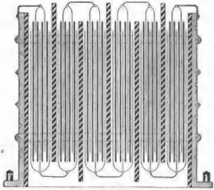
A New Condenser to Protect Wireless Generators

IF a layman were shown about the wireless cabin on board a battleship, without a doubt he would consider the rack of condensers about the least important part of the equipment. The experienced amateur knows better. He knows that should the condensers break down, the entire sending machinery is likely to collapse. Even leaking condensers may cut down the efficiency of the station so that it would be difficult, if not impossible, to comunicate over a long distance. Think what this would mean if a warship were on a scouting cruise and discovered something important!

Though it is not generally known, an accident such as this was always threatening to isolate the ships of a fleet, not very much more than a year ago. Most ships were using glass Leyden jars or glass plate condensers at this time. The immense voltages across the high-tension transformer that the jars had to stand, continually broke them down under the prolonged strains, and only protective condensers across the wireless generator, saved it from utter destruction. Moreover, brush discharges invariably took place through the glass of the condensers. These discharges increased in intensity as the glass weakened with use. The discharges contaminated the air with ozone, which made it hard for the operators to work; to say nothing about the decrease in the sending power that they produced.



A condenser built of several units, which are insulated from one another as well as each of the plates within each unit

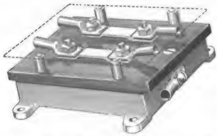


The same method is used in this condenser, although it is of very different construction

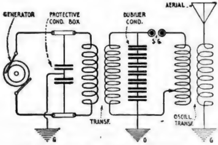
The Navy Department has now eliminated the glass condenser, and thus has done away with its disadvantages. A mica condenser, the development of William and Philip Dubilier, of New York city, is now used exclusively. This condenser is made up of a number of units connected together in series. The result is that the full potential across the transformer is divided a good number of times before it acts across any of the units. The voltage that does result across a single condenser is correspondingly small; too small, in fact, to set up any detrimental brush discharge action. Such sets of condensers ought to be highly efficient, and, theoretically, ought to last a life time.

Each of the units is built up of alternate sheets of copper foil and mica, the copper foil being connected in multiple as in ordinary mica condensers. Though the probability of a breakdown of the mica has been made exceedingly small, the chances of such a breakdown injuring the station has been made

further improbable. The thickness of the mica sheets has been so proportioned to those of the metal leaves that when a hole is burnt through the dielectric, a larger hole is burnt through the foil. Hence, in this condenser, two oppositely charged pieces of foil cannot come together through the hole made by the leaking currents. The condenser is truly self-healing.


Construction of the casing for a condenser with lead-in terminals attached. The dotted line shows the protective cover

As a last precaution against its being burned out by a short circuit, the generator has the pair of protective condensers shunting it. For these condensers, the Navy officials have also adopted a Dubilier invention, in which two of their condensers are placed. Besides its reliability, the Dubilier device is also foolproof. For, as the diagrams show, should their condenser be removed from the circuit, the generator connections would not be complete until another box of protective condensers is connected with the circuit.



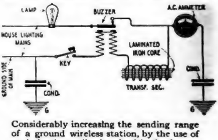
Hook-up showing positions of condensers in the line and how the connections would not be complete without them

Increasing the Range of the Ground Wireless Station

IN experimenting with inductive coils, placing them with the buzzer in the ground circuit, to see if increasing the inductance would not send larger currents into the earth, it was found that the sending range could be increased in this way to a considerable extent.

First, the contact connections of the buzzer were changed as shown in the diagram. The secondary of the sending coil was connected between the buzzer contact and the buzzer coils, and to vary the inductance, the laminated iron core was moved in and out. For some stations, of course, the ordinary variable radio loading coil will do the trick just as well.

Naturally, the sending range will be largest when the buzzer is vibrating well and the maximum current is sent into the ground. Therefore the inductive coil should be tuned as in radio work, until the ammeter in the earth circuit registers the largest current.—E. T. JONES, Chief Electrician, Radio, U. S. N. R. F.



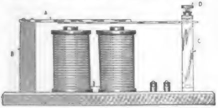
Considerably increasing the sending range of a ground wireless station, by the use of an induction coil placed with the buzzer

Where Fiber May be Used as a Fireproof Material

FIBER is an almost fireproof material. Almost—for it will burn. But, unless it is kept on fire by some outside source it will go out, and it requires a very hot flame to ignite it. So, when anyone wants to use fiber in a situation exposed to heat, he can do so. There is little danger of its burning except when it is in the direct path of a flame. The close texture of this material prevents a flame from taking hold unless forced by a draft.

A Telegraph Sounder Made from Old Bell Parts

THE sounder here illustrated is made entirely from an old bell, with the exception of only a few of the essential parts. The magnets on the bell are first



Old bell parts mounted on wooden base with attachments to make a telegraph sounder

carefully removed and screwed to the base as shown. The soft iron armature is next removed and the spring attached to it is taken off. It is then soldered to a brass strip which is shown in the accompanying illustration at *A*, and fastened to the wooden support at *B*. The bridge, *C*, is constructed of brass, but a more ductile metal may be substituted if the brass cannot be worked with the materials at hand. To obtain the best results, a small adjustable screw *D* is used to regulate the stroke of the armature. The drawing makes all other directions and constructions clear.—HERMAN NEUHAUS.

A Secret Code of Colors for Transmitting Messages

FOR Boy Scouts and others desiring to communicate by means of a secret code, the one described will prove very acceptable. The code is very simple, being composed of color combinations, each combination representing a single letter of the alphabet. Thus, it will be seen that the combination, red and yellow (ry) represents the letter A; red and blue (rb) B, and so on.

In this manner, any message can be sent, with the assurance that only the person for whom it is intended, can read it. All the colors, which are used in the following code, can be obtained by buying an ordinary box of crayons.

In writing out a message, always leave a small space between each letter and a much larger one between words.

The following code can be changed, as it is only an example.

R-red; y-yellow; b-blue; g-green; p-purple; o-orange; br-brown; bla-black.

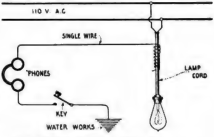
A-ry	J-yp	S-gp
B-rb	K-yo	T-go
C-rg	L-y br	U-g br
D-rp	M-y bla	V-g bla
E-ro	N-bg	W-po
F-r br	O-bp	X-p br
G-r bla	P-bo	Y-p bla
H-yb	Q-b br	Z-o br
I-yg	R-b bla	period-r

Only Uncut Diamonds Are Used to Dress Emery Stones

DIAMONDS are used to sharpen and shape emery wheels. But even if anyone were so foolish as to use it, the diamond of the jewelry shop would not do the work well, for it is the natural face and edge of a diamond that does the cutting on such work. Therefore the polished stone of the engagement ring would be of little or no value as a stone dresser.

Practicing the Telegraph Code Without a Battery

THE illustration shows how to connect phones with a key, so that sounds may be heard, similar to those produced in a radio transmitter. This plan cannot be used on direct current mains. It takes the pulsations of an alternating current to produce the effect. About 10 turns of No. 22 gage, single



Separate hook-up to an alternating current line for producing sounds like radio

cotton covered wire is wound around the drop cord, and when the lamp is turned on to get a flow of current, the hook-up is ready for practice.—E. T. JONES.

The Normal Running Temperature of Electric Machines

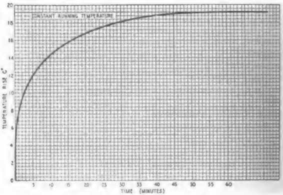
AN electric current flowing through a conductor tends to raise its temperature, especially where there is a resistance offered. In electrical terms, this is proportional to the square of the current. In designing electrical machines, this heating is kept down as much as possible, since it represents a waste of energy and is apt to char the insulation and cause damage to the machine.

It is evident that the heating up of a machine will take some time, depending on the size and cooling ability. The temperature will rise until finally a value is reached at which the temperature remains constant. This is the normal running temperature of the machine. For cotton insulated windings, it should be below 85 deg. C. For this reason, other materials, such as asbestos, mica and enamel, have been developed for purposes where the heating effect is great.

The method of procedure for the heat run of the electrical generator is as follows: Two or three thermometers are stuck to the filed coils and core of the machine with putty. Read the thermometers and record the readings; then start the generator. Allow the generator to feed normal current to a water rheostat or feed it back into the line. This latter method of using the current is in general practice because of its economy. Take thermometer readings every five minutes for at least an hour and then shut off the power and take armature core and winding temperatures. Suppose the set of readings is as follows:

Time	Temperature	Temperature Rise
12 : 00	21 deg. C.	12
12 : 05	33 " "	12
12 : 10	35 " "	14
12 : 15	36.5 " "	15.5
12 : 20	37.2 " "	16.2
12 : 25	38.5 " "	17.5
12 : 30	39 " "	18
12 : 35	39.5 " "	18.5
12 : 40	39.5 " "	18.5
12 : 45	40 " "	19
12 : 50	40 " "	19
12 : 55	40.1 " "	19.1

Plot the data as given, with temperature rise as ordinates and time as abscissas, and the curve, as shown, will be obtained. By studying the curve, it will be noticed that the temperature of the machine rises rapidly at first and then gradually approaches a



A curve obtained by plotting the data given with temperature rise as ordinates and time as abscissas

constant temperature. The reason for this is that heat transfer between the machine and the surrounding air will depend on the difference in temperature between them. At first, there is little difference in temperature between the machine and the air and therefore, almost all the heat goes to warm up the machine. But when the machine gets warm, it dissipates the heat rapidly and reaches a final temperature at which the heat generated by the current equals the heat dissipated.—ALEX V. POLSON.

A New Use for Fogged Photographic Plates

SOMETIMES, by accident a photograph[illegible] plate is fogged by exposure to lig[illegible] before it is exposed in a camera or before [illegible] is developed. These plates can be used [illegible] make a very soft negative from a harsh [illegible] The method is as follows: Place the [illegible] plate in a printing [illegible] film against film. [illegible] and makes [illegible] is pla[illegible] di[illegible]

Wireless Work in Wartime

VII.—Fundamental Principles of Radio Apparatus

By John L. Hogan, Jr.

THE six preceding articles of this series comprise a fairly complete set of instructions in learning wireless operating, from the simple viewpoint of telegraphing. Memorizing the code, reading Morse signals by sound, and practice in overcoming the difficulties of "station" and atmospheric interference have been taken up in some detail. All of these matters are essentials in the study of radio telegraphy, and they must be completely mastered if one is to become a first-rate operator. To be of the greatest value in radio work, however, and to advance in the naval, military or civilian radio services, it is important to be more than a skilled telegrapher. In addition to the ability to transmit and receive messages swiftly and accurately under even the most adverse conditions, one should know how and why his instruments work. Such technical knowledge is of the greatest use to the radio man in war work, for without it he is likely to be unable to make urgently needed repairs and adjustments. This, and the succeeding articles will go into the simple technology of radio telegraphy, and should prove helpful in studying to qualify as one of the expert radio workers who are and will be so much needed in the Signal Corps and the Naval Communication Service.

The main purpose of these articles, then, is to guide the student to a thorough understanding of the radio station, and to point out the precautions which must be taken if the best possible working is to be obtained. This will involve both the discussion of apparatus design, and the elementary theory of radio telegraphy. These two [illegible] of the [illegible] are so [illegible]sely [illegible], h[illegible] it [illegible]ly [illegible] to [illegible]e [illegible]d [illegible]t [illegible]- [illegible]n [illegible]r- [illegible]vill [illegible]lso [illegible] to which the theory applies. In these articles the concrete elements of design and operation and the reasons for them will be carried along side by side. The only theory used will be working theory, and the only constructional points explained will be those which have been found satisfactory in the experience of radio engineers in the military and commercial fields.

The Elements of Signaling Systems

To understand the radio transmitter itself we should fully understand its object. In the first place, then, let us consider the essentials of any communication system. Just as the natural act of

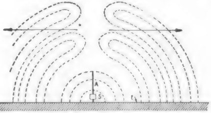


Fig. 27: General form of radio waves as they pass from the sender in direction of arrows

speaking to another person in the same room calls into play the three main elements of any system for the transmission of intelligence, so does the sending of a wireless message involve these same three things. We cannot convey ideas from one point to another without having something which can act as a transmitting medium connecting the two points. In the wireless telegraph, the connecting medium is the so-called "ether" of space, which lies between the two stations. In talking, the medium of transmission is the air which lies between the speaker's vocal cords and the listener's ear. In both cases, the medium is vibrated according to some pre-arranged code, and the vibrations pass from the sender to the receiver.

Evidently, the two remaining elements are the transmitter and the receiver. The first of these is merely an apparatus which

can in some way set the air, ether or other transmitting medium into vibration; the second is an instrument which is capable of indicating the presence of the vibrations. In speaking, the human apparatus consisting of the mouth and vocal system produces sound-waves, or compressional vibrations, in the air. The sound waves vary in intensity and pitch (or frequency) according to the signaling code with which we are all familiar and which we call a language. When the air vibrations reach the ear of the listener, they are re-converted into the sensation known as sound, and their presence is thus indicated.

The Basic Process of Radio Telegraphy

In radio telegraphy the process is identical, from the broad viewpoint. As shown in Fig. 27, a sending apparatus indicated diagrammatically by the box marked *S*, is connected with an elevated aerial wire or antenna *A* and with the ground *E*. The sender *S* sets up high-frequency currents in the wire *A*, and the rushing of these charges up and down at the rate of hundreds of thousands of complete trips per second creates vibrations or waves in the ether, which surrounds the sender and extends indefinitely into space. The general form of these waves is shown by the dotted lines in Fig. 1 and the way in which they pass off from the sender is indicated by the arrows. Just as the sound waves travel through the air and ordinarily produce no appreciable effects until they reach the receiving ear, so do the radio waves pass through the ether. They are invisible and inaudible, and produce no appreciable effects until they strike such a [illegible] elevated aerial wire. W[illegible] structure of this kind [illegible] in Fig. 28, the [illegible] small high[illegible] pressure[illegible] then in [illegible] cause [illegible] anten[illegible]

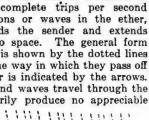


Fig. 1

The waves as th[illegible] reach the [illegible]

to and from the ground connection *E* through the receiving apparatus indicated by the box *R*, produce an indication which announces the arrival of the radio waves. If the waves are sent out in groups corresponding to a pre-arranged code, or if their intensity or frequency is modified according to the code, messages may be transmitted.

Thus, the object of the radio transmitter is to produce high-frequency currents in an elevated aerial wire system and to provide for the control of the current-production in accordance with some signaling code. This brings us to the first problem of radiotelegraphy, namely, the production of the high frequency currents. Before it can be considered we must reach a conclusion as to the numerical value of the frequencies involved.

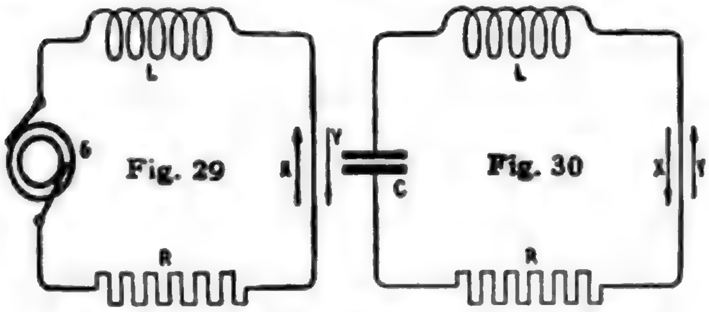
Audio and Radio Frequencies

Frequency itself, in the abstract, is merely the number of times something happens in a given interval. The postman who delivers 400 letters in his eight-hour working day is evidently giving out mail at the rate of 50 letters per hour. If a water tank holding 8,000 gallons springs a leak and becomes empty in four hours, it is clear that the water is lost at the rate of 2,000 gallons per hour or 33⅓ gallons per minute. If a sound wave is produced by a siren which ejects 256 small puffs of air in each second, the wave consists of 256 compressions and rarefactions per second and corresponds to the tone of middle C on the musical scale.

Sound frequencies range roughly from 30 per second to 10,000 per second, and air vibrations which occur at rates either lower or higher than these respective extremes are ordinarily inaudible. Such frequencies as lie within these limits are called "audio frequencies," for convenience. They correspond to various musical tones, and to the electrical current frequencies which would [illegible] tones by passing through the [illegible]tic telephone receiver. A [illegible]cles per second, which [illegible] voltage or current alter[illegible] completely 60 times per [illegible]oduce a tone a little lower [illegible] second C below middle C [illegible] Sixty cycles is a standard [illegible]rent frequency; 500 cycles [illegible] which the reversals occur [illegible]es as often, produces directly

the tone slightly below the next C above middle C, and is much used in radio telegraphy. Both of these are audio frequencies.

Frequencies of above 10,000 cycles per second are called radio frequencies, for the reason that they are most useful in producing radio waves. Wireless telegraph trans-



A closed circuit with alternator, and a closed oscillation circuit for alternating currents

mitters use frequencies as high as several million per second, which are, of course, far above the upper limit of sound or audio frequencies. Since currents of these enormously high frequencies are used in the antenna circuits of wireless transmitters, the problem under consideration becomes how to generate such electrical movements.

Machine Generation of Alternating Current

There are two practical methods of producing alternating currents over large ranges of frequency, as indicated in Figs. 29 and 30. The first of these shows an alternator or alternating current generator *G* connected in series with a coil of wire or inductance *L* and a resistance represented by *R*. The generator *G* usually consists of a machine in which coils and magnets are moved relatively to each other at comparatively high speeds, so that the coils have induced in them voltages which change in intensity and direction from instant to instant. The series of alternating voltages thus produced, when applied to the circuit, first in the direction of the arrow *X* and then in that of *Y*, gives rise to an alternating current through the resistance *R* and inductance *L*. The frequency of this alternating current depends entirely upon the frequency of the voltage impulses; if the voltage is applied 500 times per second in the direction of either arrow, the current will have a frequency of 500 cycles per second. For any given strength of voltage, the amount of current will depend upon the amount of effective inductance and resistance in the circuit, and will be less, the larger the inductance and resistance. The number of times the voltage impulses in one direction are applied per second, or the frequency, depends upon the construction of the generator *G*; the higher its speed, or the greater number of magnetic poles and corresponding coils it has, the higher the frequency of the current. This mechanical method of direct generation is used almost exclusively for production of the commercial alternating currents at frequencies from 15 to 500 per second. For radio transmitters, special generators which produce frequencies as high as 200,000 per second are built and used. Still higher frequencies can be reached by machine generation of this type, particularly if some sort of frequency transformation is involved.

Generation by Condenser Discharge

The second important method of generating alternating currents is that of the condenser discharge, as shown in Fig. 30 Here an electrical condenser *C* is connected in series with the resistance *R* and inductance *L*, to some extent taking the place of the generator *G* in Fig. 29. If we imagine an electric charge to be placed upon the condenser plates and the circuit then to be closed as in Fig. 30, it is not hard to realize that the voltage impressed on the circuit by the condenser charge will cause a current to flow in one direction, say that of the arrow *X*. The interesting feature of the arrangement though, is that when the resistance is not too large as compared with the capacity and inductance, the current will keep on flowing after the condenser has discharged itself fully, and will in fact recharge the condenser to some extent in the opposite direction. By proportioning the cir-

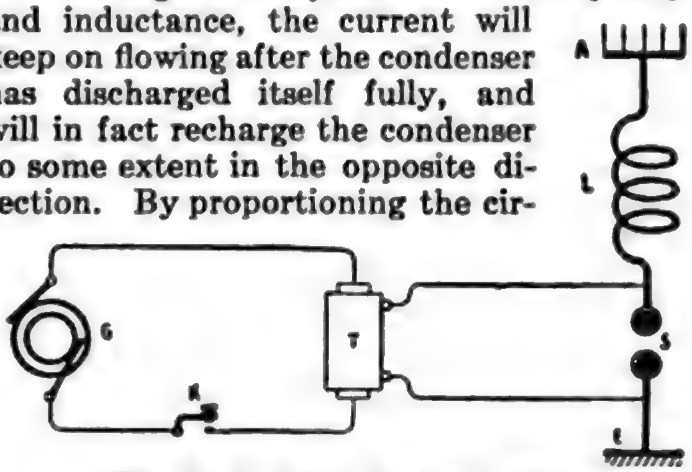


Fig. 31: A simple wireless sender with a loaded antenna circuit

cuit properly, the recharging may be made to reach a value almost as high as the initial potential of discharge. Manifestly, when the second maximum is reached the condenser will once more discharge through the induct-

ance and resistance, but this time in the direction of arrow Y. The process is repeated indefinitely, each charge growing somewhat smaller than the one preceding it, but each producing a half-cycle of alternating current, until the energy of the original charge is all used up in heat or useful work. The successive half-cycles in opposite directions unite to produce an alternating current which gradually dies away in strength or amplitude, but whose frequency remains constant. In such a condenser-discharge circuit, the frequency of the current produced depends upon the effective capacity and inductance, and, to a limited extent, upon the resistance. The rate at which the current dies away depends upon the effective values of these same three electrical quantities. The intensity of the current in the first half-cycle of the discharge depends upon the voltage to which the condenser was charged, as well as its size and on the circuit inductance and resistance.

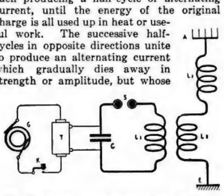


Fig. 32: An arrangement of transmitter depending on condenser discharge in closed circuit

A Simple Radio Transmitter

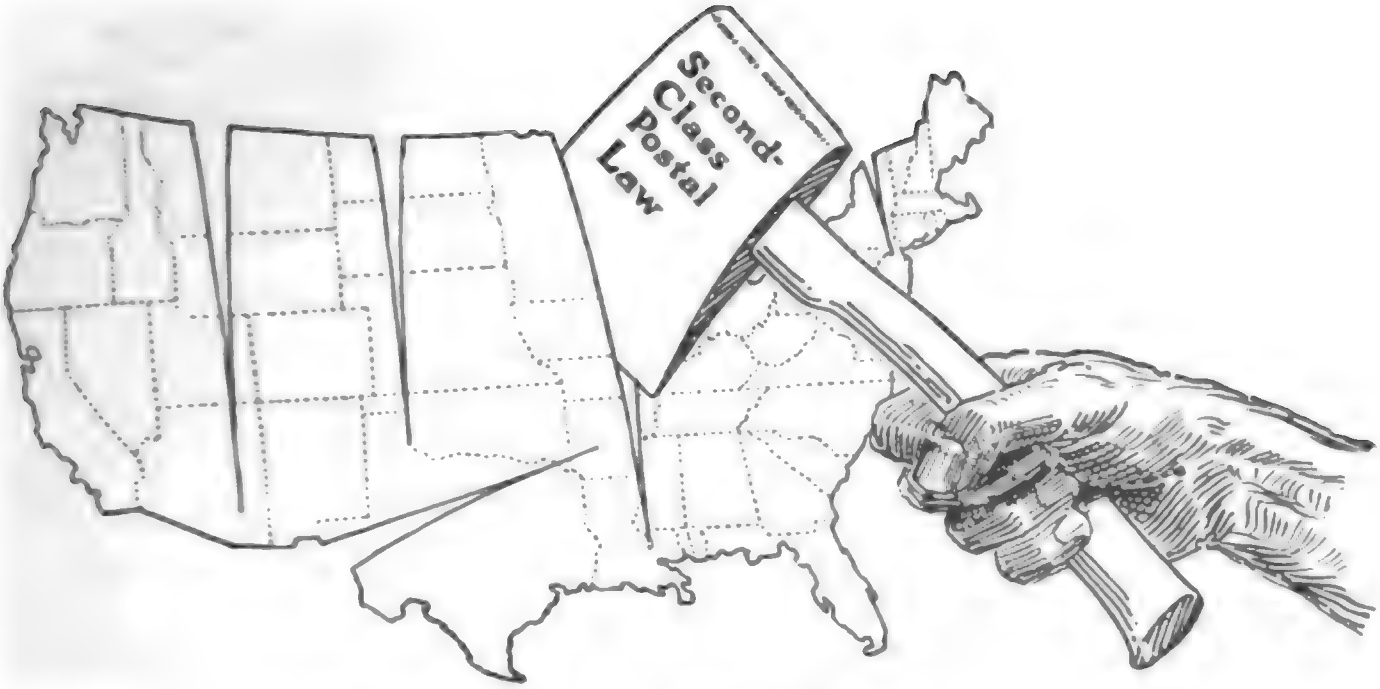
The condenser-discharge method of generating alternating currents is practical for frequencies from a few thousand per second up to millions per second, and is the basis of all radio telegraph transmitters of the spark type. One of the simple ways in which the principle is applied is shown in Fig. 31. A generator G of audio frequency alternating current, of say 500 cycles per second, is connected in series with a telegraph key K and the primary coil of a step-up transformer T. The secondary of this transformer, which produces a high voltage (of perhaps 20,000) at the applied frequency of 500 per second, is connected across a spark gap S which lies between the aerial wires A and the ground E, an inductance coil L being in series in this antenna circuit. Each voltage pulse from the secondary of the transformer puts a charge upon the aerial-ground system, since the wires in the air act toward the surface of the earth much as one plate of a condenser acts toward the other. When approximately the highest point of voltage in each charging pulse is reached, the spark-gap S breaks down and the voltage established between antenna and earth just before the rupture causes a rush of current through the coil L and across the gap S. By choosing suitable values for the inductance capacity and resistance, the discharge can be made to overshoot and to recharge the antenna capacity in the opposite direction, just as in the closed circuit of Fig. 4. Thus an alternating current is produced in the antenna-to-earth system. Its frequency is controllable by changing the inductance and capacity of the antenna circuit, and it may be stopped and started by opening and closing the telegraph key. This offers one solution to the first problem of radio telegraphy.

Two-Circuit Spark Transmitter

A type of transmitter which is preferred to that of Fig. 31 is shown in Fig. 32. It also depends upon the condenser discharge for generation of radio frequency current in the antenna. Here a condenser C receives the voltage impulses from the transformer, and discharges across the spark-gap S. The radio frequency currents thus generated in the closed circuit S, C, $L1$ induce similar voltages and currents in the antenna circuit A, $L3$, $L2$, E by means of the transformer action of the magnetically coupled coils $L1$ and $L2$. This is perhaps the most effective form of simple spark transmitter which has been used in radio, and forms the basis of by far the greatest number of radio stations in the world. It produces in the aerial wires a controllable radio frequency alternating current, and so satisfies the primary condition of the radio transmitter problem.

This article has necessarily been in the nature of a review of essentials, and could not offer constructive assistance to the student except in so far as it will help to clarify his ideas as to the underlying principles and relations which exist in the sending apparatus. In the succeeding articles these principles will be explained in further detail.

(To Be Continued)



Splitting Up the Country

DO you know that the postage on your magazines is to be increased by several hundred per cent beginning July 1st, unless you and other intelligent citizens protest strongly enough? It is a huge tax on intelligence.

For many years one cent has carried a pound of publications to any place in the country. This rate on publications is called "The Second Class Rate."

Penalized for Where You Live

In the War Revenue Bill is a clause placing a very high postage rate on the advertising pages of magazines—the rate increasing with the distance carried—in other words a zone system as on parcel post. It now costs about 1¼ cents to carry a copy of POPULAR SCIENCE MONTHLY to the Pacific Coast.

But when the Second Class Postal clause in the War Revenue Bill is in full effect it will cost over six cents to carry one copy of this magazine—over 72 cents a year, as compared with the present cost of 15 cents! Just think of it! The further you happen to live from New York the more postage you will have to pay on your POPULAR SCIENCE MONTHLY and on all the other magazines you read that are printed in New York!

You know that if you bought the contents of one issue of POPULAR SCIENCE MONTHLY in book form it would cost at least one dollar, and probably a good deal more. But you buy POPULAR SCIENCE MONTHLY for 15 cents.

This is made possible by the one-cent-a-pound postage and by the advertisements. To place a huge tax on the advertising pages is to kill the goose that lays the golden eggs.

Why does Congress, now, in the midst of the War, want to throttle the press, the one vital force that keeps the country united? It was by the jugglery of Congressman Kitchin that the Second Class Postage clause was passed as a part of the War Revenue Bill. A little group in the House of Representatives proposed it, the Senate voted it down; then the little group put it back, and insisted. You know how the discussion in Congress on the War Revenue Bill dragged and dragged. Finally, the only chance of passing the Bill was to take it all—hook, line and sinker, including the vicious postage tax on magazine readers—and it was passed!

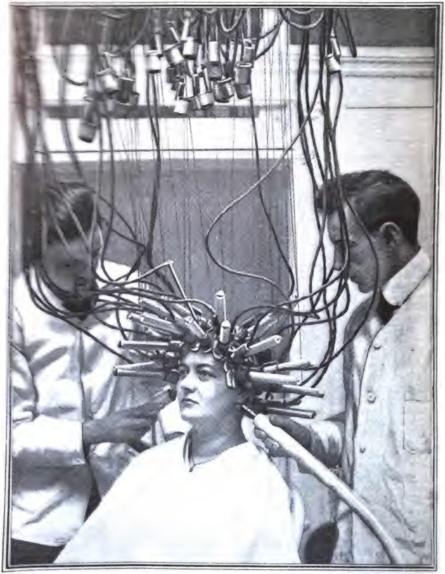
What You Should Do About It

No, The Zone System must be repealed before it goes into effect on July 1st. The Senate thinks it vicious. The people don't want it, and they must protest.

You and every reader of magazines should write to your Senator and your Congressman; tell them that you want the Zone System repealed.

If you want the names of your Senator and your Congressman, or any other assistance, write to the Editor of POPULAR SCIENCE MONTHLY—he will gladly help you.

Man-made Beauty—Electrically Baked Curls



This is not a close-up view of the head of the Statue of Liberty. It is just the picture of a good wife endeavoring to please her husband by having the straight hair he detests turned into the enchanting curls he adores. Her hair is being baked electrically. Ten minutes of this baking and she has curls that defy the straightening effects of shampoos or sea fogs

Popular Science Monthly

225 West Thirty-ninth Street, New York City

Vol. 92
No. 3

March, 1918

$1.50
Annually

The Secret of Those Curly Locks

Science steps in and waves
the straightest hair

FOR years and years, probably ever since Eve's day, seductive woman has tried to fulfill man's idea of loveliness. Does he admire blondes? Forthwith the peroxide bottle appears. Does he prefer curly hair? The dear ladies undergo tortures in sleeping on lumpy curl-papers, and burn off enough hair with hot irons to supply the armies of the world with mattresses. Every drug store is a beauty shop, crammed with numberless lotions, ointments, freckle removers and skin foods, all to be applied in the endeavor to please man's critical eye.

Man has watched this struggle of woman throughout the ages. When he found he couldn't bear the spectacle any longer, he gallantly came to her relief. It is he who invents and manufactures all the wrinkle-removers, chin-straps, hair-trainers, and lip sticks. Even science takes a hand in the game. Step right up ladies. Give two hours of your precious time to the scientific beautifier. Fido can get on without you for that long and the great bargain in yon shop will be there two hours hence; so step right up and change yourself into a Mary Pickford.

Your hair is straight, and you want it waved—permanently? Walk into this little room. It is spotless white and gleaming gold, quite to your feminine taste. What are they doing now? Just tying a rubber mat in back of your head. Why are they swathing you in sheets? To protect your clothes. Next, they take down your hair, and you lean back luxuriously, your head over a basin, while your hair is given a thorough shampoo. What dries it so quickly? Electricity, my dear.

"Please walk in here," says the scientific hair man. It is another little room. Above your head is something that looks like a huge, old-fashioned chandelier. Only instead of lights, about fifty little round devices that look like sockets for electric lights hang on long, pendulous green cords.

You are seated directly beneath this device. Quick, deft fingers dampen your hair with a solution. But what's this? Oh, he's wrapping it around small, hollow pieces of metal. They are curlers about a quarter of an inch in diameter and about four inches in length. Each curler is fastened in one of the pendent sockets. The current is turned on.

For ten minutes you sit breathlessly awaiting the miracle. The current is turned off. The baking process is over. They wash your hair and dry it again. Now look in the mirror. Your astonished and delighted eyes behold a perfect riot of curls where straight wisps disgusted you but a short time ago. But that's not all.

Man has done much for woman, but he hasn't been able to make her hair grow in curly. Perhaps he will, by and by, who knows? In the meantime, your hair will grow, and if you want those curls to start in right at the root of your hair, you have to have the new hair curled once every six months. The long hair that was first curled will retain its curl to the end of time.

When the permanent wave was first invented, the process was much more troublesome than it now is. It used to take nearly all day to do the trick, but to-day it is possible to have the whole thing over and done with in two hours.

Butchering an Automobile to Make a Tank Holiday

We have been hearing for months of the terrible destructive power of those new Goliath's of war, the British tanks. In motion pictures we have seen them amble along in and out of great shell holes, crawling over trees and barbed-wire entanglements and crushing everything beneath them. It would seem as if we were a tankwise people. Not so, however, with the Canadians. Like the Missourians, the Canadians had to be "shown" to be convinced. In other words, the army authorities in Toronto, Canada, had to run a tank over a perfectly good automobile to prove that it was capable of destroying something.


Toronto watched and laughed while a big monster of a tank ran over an automobile. You can see the result

The accompanying illustration shows that the tank did its work well. The automobile—a limousine—was placed in the street on a thin sprinkling of earth. The tank approached, crushed the rear part of the machine to bits and then returned and ran over the front portion. Even the tires, which appear to be new ones, were not spared in the general wreck. We have several friends who would have taken good care of that poor, helpless automobile.

They Can Always Borrow a Few Fine Names from the Patent Medicines

Finding names for newly discovered asteroids, or minor planets, is getting to be as difficult a problem as naming the Pullman cars. The names of heathen divinities were all used up long ago. Among the more outlandish names now found on the list are: Ottegebe, Dudu, Juewa, Abnoba, Libussa, Ilmatar, Aaltje and Siegena.

Can the Little Lady Now Bump Her Head? She Cannot

A little girl, sixteen months old, just learning to walk, toddled to the edge of her home porch one day—unseen. She dived from the veranda to the concrete pavement which was six feet below.

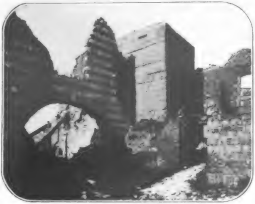
Her father, hoping to prevent similar accidents, invented the protective helmet here shown. The total weight is only six ounces in the small size. A cloth inner cap and a padded band make it so comfortable that a child forgets in five minutes that it is wearing anything unusual.


With a pillow strapped to her back and this guard on her head, the young lady should be ready for all bumps

Larger sizes and different patterns are made to meet the requirements of industrial workers who need head guards.

Can You Tell Which Part of These Ruins Is Camouflage?

THE French invented the word camouflage, but the Germans are fast becoming past masters of the art—as witness the accompanying photograph. Between two shell battered walls of the church at Moncy-aux-Bois they built a concrete observation tower with slits for machine gun operations. So cleverly colored and arranged to fit the general landscape was this little addition, that from a distance it looked like a part of the original ruin.



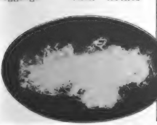
French Official Photo

A cleverly camouflaged observation tower which contains slits for maneuvering real machine guns

Let the Flames Roar. He Wears an Asbestos Suit

A FIRE-FIGHTING suit of asbestos cloth is one of the latest and most useful of the many practical applications of this remarkable mineral substance. The long, gossamer shreds of the snowy-white mineral, soft as thistle-down, are woven into a firm, heavy cloth which can be used for gloves, coats, trousers and leggings. Such clothes would be a protection to firemen and workmen about electric furnaces, blast furances, glass plants and wherever else high temperatures must be encountered.

The well known heat resisting properties of asbestos, together with the fact that, unlike any other mineral, it will cleave into fiber, delicate as flax, make it the one substance in all nature ideally adapted to such a purpose.



The long, gossamer shreds of the snowy-white mineral, soft as thistle-down, can be woven into firm, heavy cloth

Here's a New Cutting Steel

WORD has come that is of much interest to American mechanics. The English have recently invented a strong and superior high-speed steel. Such news to the layman may mean little. But to those who know, it is as welcome as the news of a great land victory. Why? Because that side which can turn out war machinery the fastest will win the war!

With this new tool steel—"colbaltcrom," it is called—engines and guns can be worked faster with out the added heat that develops and affects hardness and rigidity.

Tools of this steel can be cast into shape, and casting is the quickest known way of making any tool. There are few steels, however, which by casting them do not become brittle. "Colbaltcrom steel," nevertheless, can be made in this manner instead of having to be forged and rolled, two very much lengthier and more expensive processes.

Let the Sausage Balloon Speak to You on the Screen

SCENE: Palm Beach, Florida. Artemus is observed employing every known photo-play gesture to express his infatuation for Viola Dewdrop. It's plain that he is desperately in love. You know he is talking, for you can see his lips move. Viola Dewdrop seems dramatically happy.

Do you want this beautiful, heart-gripping picture of human interest suddenly cut off, and the usual, cold, distracting, explanatory type matter flashed in its place? Certainly not! So here is a suggested improvement.

Upon the sausage-shaped balloons appear what these motion-picture actors are supposed to be saying

The picture remains on the screen. Suddenly Artie's cheeks puff out and he blows squarely into Viola's face. If you have never before witnessed this type of photo-play you may think that Artie is trying to blow the powder from Viola's nose. That is not so. Somewhere in the cavity of one of his teeth, Artie has been concealing a rubber balloon. He has suddenly grasped the open end of the balloon between his lips and as he blows, the balloon is inflated until it assumes the form of an over-sized sausage. Upon this balloon appears in plain words, exactly what Artie is saying. Is this not a marvelous idea?

The mystery is all cleared up now. Artie says "I adore you." Now it is Viola's turn to blow. On her rubber sausage appears the words "What will the neighbors say?"

Meanwhile Artie's inflated balloon shrivels up. Another which was secreted in a cavity in his wisdom tooth takes its place. This one says, "We'll move to Barren Island where there are no neighbors," and so on.

In order to produce a photo-play of this type successfully, we believe it will be necessary to employ players with plenty of teeth. Each tooth will have to be carefully hollowed out by an expert dentist to provide for storage of the various visible speech-balloons. With a little practice and patience, the player will have no difficulty in locating with his tongue the particular balloon required. Temperamental and impulsive artists must be careful lest they blow too hard and burst their words.

Last September, Charles F. Pidgin proudly patented this inflatable speech-sausage. Congratulations, Charles!

The Original Model for All Baby Carriages Comes from China

A LITTLE Chinese baby, who has been an ancestor now almost too long for even a Chinese memory to recollect him, may have been the first infant to be rolled out in a real perambulator.

The design for the queer little vehicle, shown in the illustration, dates back into such a dim past that Confucius himself is credited with its invention in a benignant moment. It's resemblance to a Noak's Ark also speaks for its exceedingly ancient origin.

An antique Chinese perambulator. A primitive canopy shields the baby from the sun

Let This New Chair Add to Your Bathing Convenience

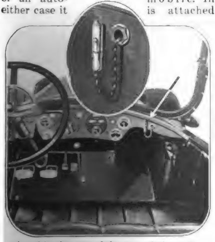
MR. FRANK BEHM, of Toledo, Ohio, has invented an adjustable chair for the bathtub. As the accompanying cut shows, it can be hooked on the end of the tub, the user reclining somewhat at ease, above tide level, while he performs his ablutions at leisure.

But the use of this appurtenance is not necessarily confined to the bath. Hooked on the rail of the back piazza it would do for a small-tub stand while washing out baby's stockings. Attached to a rail fence at a Sunday School picnic it might save the lunch from the ants.

This legless chair hooks over the edge of the tub

A New Automobile Cigar-Lighter

THE new type of electric cigar-lighter shown in the accompanying illustration is designed to be mounted either on the dash or on the rear of the front seat of an automobile. In either case it is attached to a cord which is automatically wound up on a reel, enclosed in a case which forms the back of the plate on which the cigar-lighter is held.



A reel in the rear of the case winds up the cord when the cigar-lighter is not in use

The lighter is prevented from rattling while the car is in motion by means of a small spring-clip attached to the face plate of the mounting. Current is obtained from the battery in the car.

The Germs in a Swimming Pool

PUBLIC baths and swimming pools are a source of both benefit and pleasure to a community, but they are exceedingly dangerous to health unless they are kept in a sanitary condition. Water which has been contaminated by sewage is always unsafe for bathing purposes. Another source of contamination is from the bathers themselves. The water of a Liverpool bath was examined to determine how much the bathers contaminated it. It was found that each bather contributed about 4,000,000 germs to the water of the swimming pool in ten minutes. In the second-class baths which are patronized by small boys, it was found that each bather added 6,000,000,000 germs to the pool during a similar period. At the end of the day, the water held no less than 4,676 germs per cubic centimeter.

The germs which are a danger to health are those of intestinal origin. The presence of other bacteria does not make the swimming pool unsafe. If the water is treated with chloride of lime it can be rendered perfectly sterile. When certain precautions are taken and the bathers themselves instructed in the rudiments of personal cleanliness, there is no reason public swimming pools should not be of great benefit to a crowded community, especially during the uncomfortably hot summer months when cool baths do so much to make the heat bearable.

Have You Wondered Why So Many Fires and Explosions Occur These Days? Here Are a Few of the Reasons

These choice gems are made of tin and contain thermite, a priming composition, and a time fuse. The heat of the thermite easily starts fires

Norwegian police seized the bombs shown on these pages from German couriers. Were they en route to this country? German agents do not tell too much. Above is a chemical detonator; at left, a mechanical one with clock. Both are deadly

They carried them around beneath coats, and in suitcases

The interior of a coat parcel. Look out for the central cylinder!

A nine-foot bomb filled with thermite

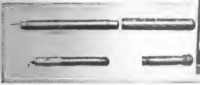
It's Bombs Such as These That the Kaiser's Agents Have Been Using to Blow Up Our Factories and Ships

Throw the coal bomb in a ship's furnace and then—Look Out!

Papier-maché bomb made to resemble coal and filled with exceedingly high explosive

In center of bomb is space for ignition mechanism and detonator. The rest is trinitrotoluol and fiendishness. Many such are made

Another of the tall thermite bombs



Fountain containing batteries, a detonator, and high explosives

These bottles are full of a powerful acid to eat off detonator wires

Sardines Mean Wealth to Bretons

Trimming the sardines, by cutting off their heads and tails is the first step in preparing them for high-grade canning

Here the cans, already packed with fish, are filled with oil from the big tank shown in the foreground

The final steps in the canning process are the sealing of the packed cans and the printing of the ornate labels

Armless, But Not Helpless

Theophile Jankevitch-Bartoni, an artist who lives in Paris, although without arms, can play cards, skilfully using his feet in place of his hands

He has learned to shave himself, using an ordinary razor with his foot as other persons do with their hands. He doesn't even look uncomfortable

Even the "manipulation" of the keys of a typewriter does not seem to present any insurmountable difficulties to this clever artist

The picture below shows the armless artist in his studio, painting a picture, deftly putting on the finishing touches with his pliant foot

Photos © Int. Film Serv.

Bearding the Ice Giant in His Lair—The Glory of Mountaineering in the Alps

Only those who have tried it and who have met with success can ever understand and fully appreciate the fascination of mountaineering in the high Alps. The greater the difficulties and obstacles, the more serious the risks of the ascension, the more genuine pleasure does the true mountain tourist derive from his hazardous undertaking, which is a pleasure trip to him

undertaking which requires a cool head, a stout heart and plenty of reasonable precaution has been taken. A single slip or the caving n which rests the ends of the ladder would be equally fatal

One of the most strenuous, dangerous and fascinating phases of mountaineering in Switzerland is the conquest of the rugged and forbidding looking peaks of glacier ice which rear their heads above the clouds. To accomplish such an ascent is a severe test of human courage and endurance not easily forgotten by the daring tourist. It is extremely unsafe to undertake such ascents without the assistance of experienced guides. The neglect of this precaution by tourists causes many fatal accidents

Photos © Press Illus. Serv.

Real mountaineering is practically impossible during the winter months and the tourists in Switzerland, particularly at St. Moritz, which is famous as a winter mountain resort, find an outlet for their energy and love of exhilarating sport in bobsleighing down the long slopes

Made in Winter's Open Air War Studio

This snowman representing a Polish Rabbi was made by a German soldier in Galicia

Winter has draped one of the Sirens of the fountain, at the Place de la Concorde, Paris

...nt are responsible for this clever bit of snow sculpture, ... automobile after a trip in a very heavy snowstorm

Sampans, the Quaint Fishing Craft of the Far East

Photos © Newman Traveltalks and Brown and Dawson

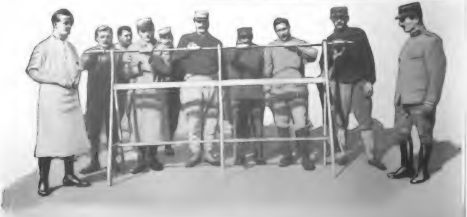
At top: Sampans, the popular fishing craft of China, Japan and neighboring islands, lying at dock. All sampans are characterized by the mat roofing. In spite of all foreign accessories, they closely resemble American skiffs

Above: A Chinese mother sailing a sampan and carrying her child on her back in much the same manner that an Indian squaw carries her papoose. Most sampans are propelled with a scull; this one has a large, picturesque and dirty sail

Restoring fingers to suppleness after an operation. They press on keys. The French have found such methods of much use

Major Bellemanière, Surgeon of the Fautras Hospital at Brest, France, is the inventor of the apparatus shown on these pages. They are simple, yet effective. At right: Walking over an inclined board cures stiff legs; by making their joints supple

Below: Turning the heavy rollers with the fingers loosens joints. The rollers wind up weighted cords; which makes a much greater effort necessary



Wounded Men Agile Again

An arm exerciser. The convalescent soldiers seize the dangling weights and work them back and forth. Several machines are here seen in operation at one time

Below: Learning to walk again. Wounded soldiers who are all right as to legs assist those who are not. Medical officers carefully direct the important work

Above: Stepping in the pigeon-holes requires careful walking. It re-educates muscles and joints long unused. Here seemingly lost abilities are regained

At right: Exercising arms and shoulders. Each day the soldiers try to reach higher rungs on the tall, test-ladders

The Man Who Invented the "Tank"

The Dreadnought of the Battlefield and Its Father

This is Sir William Tritton beside one of his newest and hugest tractors, useful in dragging the heaviest artillery. He and Col. E. D. Swinton are the inventors of the far famed "tank". Concerning the advent of the tanks, the widely-known English writer, Ian Hay, recently wrote:

"Down in the forest something stirred. From the depths of the wood opposite came a crackling, crunching sound, as of some prehistoric beast forcing its way through tropical undergrowth. And then, suddenly, out from the thinning edge there loomed a monster—a monstrosity. It did not glide, it did not walk. It wallowed. It lurched, with now and then a laborious heave of its shoulders. It fumbled over a low bank. It crossed a ditch, by the simple expedient of rolling the ditch out flat. In the middle of the clearing, twenty yards farther on, gaped an enormous shellcrater, a present from the Kaiser. Into this the creature plunged blindly, to emerge, panting and puffing, on the farther side. The tank took notice of nothing. None whatever. She simply went waddling on, onward—toward Berlin."

Just As If They Were In Airplanes

Because radio men are sent up in airplanes to direct the fire of the big guns in the rear, the United States Army has established a new interesting school

At our aviation schools an attempt is made to mimic actual working conditions as closely as possible. Here a wireless student is looking down on a panoramic map as he would from an airplane. He flashes back what he sees

The boys in the gallery see objects on the map just as they would from a height of 6,000 feet. The instructor makes lights flash on the map, indicating artillery fire. The students signal opinions as to hits and misses

Did They Do a Good Job the Last Time They Vulcanized Your Tires? It Is By No Means a Simple Piece of Work

First the tread should be stripped back several inches from the rupture as here shown. Next "step" back the inner plies

Photos © Press Illus. Serv.

If the plies aren't "stepped" back; that is, cut off one behind another stair-step style, all the breaks in the fabric come in one place. There is no interlacing of layers; so a blowout can very easily occur again

Be wary of the tire-vulcanizing job that is simply a corking-up of a hole with a rubber plug. It will not hold for long, nor will it ride smoothly. At right: Carefully smoothing up a tire before vulcanizing it

Above: At the vulcanizers. No cook ever needed to know more about his job than must the tire vulcanizer about his. Rubber can easily be overcured, undercured, blistered, hardened, and rendered in bad humor generally

Above, at right: Repairing an inner tube. First trim back the edges and wash with benzene. Apply cement. Let it dry. Insert a piece of repair sheet. Fill in the hole with gum until it is flush with outside of tire

Above: Trimmed-away holes. Back of these, and inside the tire, go the pieces of sheet rubber (raw-gum side toward operator) that serve as a backing and reinforcement of the rubber-gum filler which is used.

At left: Vulcanizing inner tubes. It takes only a relatively few minutes to cure inner tubes. The work is done on a flat plate heated by steam and equipped with short, hinged, clamping levers

Would She Be Crushed by the Sea?

How the Navy finds out if submarines may be submerged with safety to great depths

By Robert G. Skerrett

IT has recently been said that many of Germany's submarines have been carried to the bottom by reason of inherent weaknesses—structural faults, in brief. This means that the hastily built U-boats have sprung a leak and foundered simply because the defects were not discovered before sending the craft out upon active service.

The Italians shrewdly anticipated the results of wartime pressure in turning out in haste a large number of under-water torpedo boats; and Major Cesare Laurenti cleverly designed a testing dock which would make it possible to subject a submarine to the physical stresses of submergence at any practicable depth without risking the boat the while in deep water. That is to say, the submersible could be tested in harbor, right at the building yard, where her constructors could make sure that she was absolutely sound in hull. The United States Navy also uses the Laurenti dock to determine the fitness of its submarines for sea.

How can this be done? The hulls of these vessels must be sturdy enough and tight enough to withstand the searching pressure of the sea 300 feet down below the surace. Laurenti's novel dock consists mainly of a long steel tube which is capable of resisting a pressure from within corresponding to a crushing force at any prescribed submergence; only the dock always remains at the surface. One end of the tube is permanently and [illegible] when the dock is in proper condition, a submarine can be floated into the tube, settled upon keel blocks and otherwise held from shifting when the gate is sealed.

The cylinder is completely filled with water. The submarine is then subjected to external pressure just as she would be if lowered deep into the sea. But there is this difference; her crew are inside of her and stationed where they can watch for leaks and observe certain instruments that show how much the hull yields to the exterior water pressure, and whether or not the structure returns to its original lines when this pressure is relieved. The testing pressure is gradually raised by means of powerful pumps on the dock. They try to force more water into the already filled cylinder, and thus the submarine is subjected to a crushing force which can be raised to correspond with that at any assumed depth.

During the test, the observers in the submarine are in telephonic communication with the people in charge of the pumping plant, and should anything go wrong or a grave leak develop, the pressure can be lowered instantly and the great tube drained in a few minutes. Thus, while imitating the conditions of a deep submergence there are none of the dangers that might be met if the boat were out at sea.

In the last few years, under-water torpedo boats have been modified in order to meet changing military needs. The Laurenti dock makes it possible to try them out before going into actual service.

[illegible]ll inside, the [illegible] closed

American "Tin Fish" are Tested in Cylinders

The Laurenti dock makes it possible to test submarines under conditions approximating deep-sea submergence. The submarine goes inside, the door shuts and water under any pressure desired is forced in. Defects in construction soon reveal themselves. The crew inside the submarine telephones results to helpers without. Submarines deteriorate quickly, and frequently where least expected. This method of testing is sure in result. The dock may be used in salving sunken submarines

Ventilated Costumes for Use in the Arctic Circle

EVEN in the Arctic Circle, there is danger of perspiring when the temperature is endeavoring to drop through the thermometer. The colder the weather, the greater the danger. Swathed in heavy furs, as the white man goes, he may get overheated while traveling. When he stops to make camp, he will freeze in a very short time. Terrible suffering is the result.

The Eskimo has solved the problem of how to keep warm without perspiring, in a simple but original manner. Instead of covering himself completely with Arctic furs, he leaves some portion of his body partly uncovered. This allows the air to penetrate between his heavy furs and his body and ventilates his costume.

This Eskimo woman wears a costume in which there is an open space for ventilation between the boots and the trousers

If the Eskimo woman from East Greenland, shown in the illustration, remains out of doors for some time in the most severe part of the year, she covers the middle of the open space above her boots with belts of foxtails, but adjusted [illegible] that she will get [illegible] ion.

[illegible] the men's suits [illegible] the waist, be- [illegible] ers, while the [illegible] rthern Canada [illegible], which expose [illegible] to the cold air. [illegible] protected when [illegible] wore this costume [illegible] Arctic exploring [illegible] LEDEN.

Unlimited Heat—But How Can You Use It?

WHY should we enrich the coal barons every winter, in order to keep warm, though in summer we have such a superabundance of heat that we must pay tribute to the ice kings in order to be comfortable? It is exasperating to think of the warmth that goes to waste in the dog days. How soon will mankind discover a cheap method of bottling it up for use when wanted? Equally tantalizing is the thought of the enormous amount of heat in the interior of the earth, which, as far as we know, is of no use to anybody. Why can we not tap it, for use both as heat and power? Attempts have been made by engineers to harness hot springs, but the power thus produced was insignificant. It has been suggested that the continuous streams of lava which flow to the sea at Stromboli, in the Mediterranean, might in some way be made to do useful work. Sir Charles Parsons, in an address before the British Association for the Advancement of Science, once discussed the feasibility of sinking a bore hole 12 miles deep, at which the temperature of the rock would probably be more than 270 degrees Fahrenheit, and down which water would be pumped to return to the earth's surface at a high temperature. Such a boring would cost millions of dollars, if it could be made at all.

It would surely be sinking money "in a hole in the ground!" But it won't be done for some days yet.

Here Is Another "Shortest Road in the World"

YOU have heard of shortest railroads before. Always they're the most abbreviated ever. But off-hand one would grant the prize to Missoula, Montana. It has a railroad only one hundred feet long. It connects the Northern Pacific with the C. M. & St. P. and is used as a transfer. It has no equipment, no employees, and no stations, yet the company that owns it gets fifty cents for every car that passes over its rails. Sixteen thousand have done so thus far. Think of it!

© Underwood and Underwood

The clock now forming the front of a British Tommy's hut was part of a church tower destroyed by the Germans

Steaming Frozen Coal Out of Freight Cars

THE advantages of persuasion over force have received mechanical application in removing coal which ice had frozen into an immovable mass while it was waiting in freight cars on one of the sidings of a big New York terminal.

Some railways tried to blast the much needed fuel out of the cars, then a railroad man conceived the idea of inserting steam pipes into the coal to thaw it into an amenable state. This persuasive measure was successful, and the coal was soon quite loose and ready for quick removal.

Time Is with the Allies—The Strange Fate of a Clock

THE German's have tried many unsuccessful expedients to catch progressive Father Time and force him back into his medieval trappings, which they believe to be still in fashion.

When the picturesque old church at Etrelliers fell before the enemy's artillery, though the shell of the symbolically sacred structure was absolutely ruined, the clock escaped destruction.

Now it forms the front wall of a British Tommy's hut which is perched in front of the sheltering pile of debris. Time is with the Allies.

© Int. Film Serv.

Steam pipes are inserted into the frozen mass to thaw the much needed coal loose. The plan is eminently successful

Louisiana Has Adopted Cactus Candy

LOUISIANA has a new product. It is cactus candy. The cactus is peeled, dipped in hot syrup or molasses, and coated with powdered sugar. Many cane syrups and other similar products are common in every home in the south, so the confection is easily made. Sugar mills are also taking it up as a side product to be turned out during the slack seasons of the year.

And Now the Liberty Hospital

Dr. Osborn's plan contemplates sectional structures adaptable for dwelling purposes after the war

WE have the Liberty Motor and the Liberty Truck and now we are to have the Liberty Hospital. Heretofore hospital buildings have not served any purpose after their usefulness during war. The new Liberty Hospital as designed by Dr. Henry Fairfield Osborn, President of the American Museum of Natural History, may be converted into dwellings when the war is over.

Showing how the panels may be slid one over the other if it is desirable to open up one side of the hospital. Each of the side sections has two windows

The model of the New Liberty Hospital as designed by Dr. Osborn, of the American Museum of Natural History, and constructed by Mr. H. F. Beers

A complete model of this hospital was constructed by Mr. H. F. Beers, Superintendent of Construction of the American Museum of Natural History. The miniature hospital is complete in every detail. The side sections can be pushed out from their accustomed alignment into a small track at the top of the outer walls on which they can be shoved entirely out of the way. On warm sunny days, the wards of the hospital can thus be exposed, or the panels may be so manipulated as to screen half of the length of the wall.

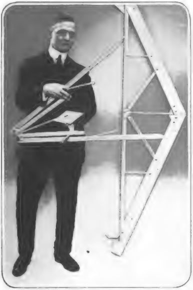
The hospital will be built in five foot units. On one side, and on one end are large porches. The supports of the porches are held in place by devices similar to steel hooks which are used in joining together the joints of old fashioned beds. The veranda roof is made of canvas and can be rolled up and unrolled as easily as can the ordinary awning. The end panels are four feet, nine inches by eight feet, and the side panels are five feet wide by seven feet deep. The floor is made in sections of five by seven feet and the ceiling panels have the same dimensions.

The material which is to be used in these hospitals is cedar, a wood which should last for fifty years. The roof trusses are of steel. They are so hinged that they can be folded into a remarkably small compass which makes transportation both easy and comparatively inexpensive.

The hospital itself may be heated by

After the war—a cozy dwelling made from a detached section of the Liberty Hospital

steam supplied from plants outside the walls. But after the war, when the hospital has been converted into dwelling houses, these houses would have to be heated by stoves. The parts of the hospital are adjusted with such care that the buildings may be taken down, transported and put up as dwellings which may eventually harbor thousands of the homeless refugees when they return to their devastated towns in Belgium and France.



A truss opened and one being folded for transportation. Note how small a space the folded truss takes up

Brrrrrrr! It's Cold!

Turn up your collar, thrust your hands to the bottom of your pockets, and read about the "Cold Pole" of northern Siberia, where the natives speak patronizingly about Greenland's icy mountains and other such relatively balmy resorts. At the town of Verkoyansk, which would probably never have had any inhabitants if the late Czar's government had not sent occasional batches of exiles thither, the temperature has been known to drop to 90 degrees below zero, which is a "record" for the whole world. While the regions about North and South Poles of the earth are cold all the time, the Siberian Cold Pole gives its inhabitants a comfortable let-up in summer, when the thermometer frequently climbs up into the eighties above zero. During the brief summer season, the life-giving rays of the Sun, which remains above the horizon day and night for some time during the height of the season, exert an intensely stimulating influencing upon the vegetation, and the ground is covered with flowers.

What Kind of a Dog Was It That Went Into Noah's Ark?

"THE ancestry of the dog has been the occasion of much controversy. Many naturalists have considered that it is descended from a single ancestor, such as the common wolf of Europe. Darwin, however, leans toward the theory of multiple origin, and advances much convincing proof in support of his belief. It is well known that many savage tribes have dogs which appear to be simply half-tamed representatives of the particular wild-dog-like animals inhabiting the same regions. The dogs of the American Plains Indians closely resemble the small prairie wolf, or coyote; the husky of the north country is plainly not far removed from the gray wolf; the German sheep dog and the Samoyede are strikingly wolf-like in appearance. Whether our present dogs are the result of crossing these many simple derivatives of wolves and jackals among themselves, or whether there was an original ancestral dog, now extinct, with which the blood of other species has become mingled, we have not yet been able to determine, though so many primordial animal remains have come to light.

"According to St. George Mivart, the dingo is the only wild dog still existing which meets the requirements of an ancestor of our modern breeds. This species is found throughout Australia, and fossil bones which have been found show its presence there from very early times." (*Pets*, by Leo S. Crandall, Henry Holt & Co., New York.)

All the specialized knowledge and information of the editorial staff of the Popular Science Monthly is at your disposal. Write to the editor if you think he can help you.

Screen Thrills Are Cheaper Now

How the motion-picture man saves money

By Prescott Lecky

(Part I) The Start of a Thrilling Accident

In a recent film, the scenario called for the destruction of a high-powered automobile at a railroad crossing, it supposedly having stalled at this thrilling point just as a train arrived. An exact replica of the real machine was made of tin and wood, and brought to the location on a truck as shown above. The real machine is in the foreground. What happened next is shown on the page opposite. The details are harrowing. We shudder.

IN the early days of the motion picture industry, directors were thrifty to the point of parsimony—for money was scarce. Then came an era of wild extravagance—for money was plentiful. And now, having swung too far both ways, the financial pendulum has finally settled down to a business range. This is the day of sane economy—for money is money. And that is why some of the ingenuity that was formerly devoted to spending money is now occupied in saving it. So long as the result remains convincing on the screen, the efficiency man is welcome.

The greatest field for intelligent retrenchment lies in those scenes that call for wholesale calamities and destruction. Until very recently, the automobiles destroyed were the real thing; very old, as a rule, and cheap makes, but real automobiles nevertheless. To-day, the directors of even the wealthiest companies try to avoid this useless expense. If the effect on the screen is just as good, the effect on the expense account is even better.

How They Fool 'Em

The above photograph is an excellent illustration both of the effect of the "long shot" and the "camouflage." The "long shot" is a picture taken at a distance, and the obvious result is an obliteration of detail. In this case, as closer examination will show, the cars were not damaged at all. After the apparent collision, shown from a distance, the seats were thrown out, a wheel taken off and a cloud of dust thrown up during the making of the close-up. In other words, the director takes advantage of the well known fact that disorder looks like damage. He gets satisfactory screen effects.

Much cheaper than the dummy model is a literal application of the well-known "camouflage." A cloud of dust before the eye of the camera works many convenient miracles. The pictures take up details.

Saving Money on the Screen Thrill

The Thrilling Accident—Part II

As per scenario, the real car stopped on the tracks (see picture in circle) and the occupants jumped out just in time. The dummy car was then substituted. The engine went back up the line and again rushed down upon the crossing. The photograph at left was taken at instant of contact. Note front wheel

The Thrilling Accident Part III

And here, at right, is the final scene. The wreck is just as convincing as if it were a $3,000 car. It probably cost less than one-tenth that sum. This is the sort of efficiency that is really worth while, according to present-day studio ideas. Take care of the pennies!

Wherein a Car Skidded

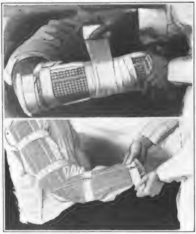
Below: This is a "flash" that immediately followed a skidding scene. The skidding was accomplished harmlessly through the help of a greased pavement, but to show a bad wreck, the car was later taken apart and stood up as shown. Then the players mounted the piled-up parts, and the effect was realistic

The Skidding Made You Gasp

The [illegible] mediately [illegible] thought you saw the car [illegible] and before [illegible] the w[illegible] the car was [illegible] back, the wh[illegible] about. [illegible] make the [illegible] convincing. Above we show the final scene

Wire-Netting Instead of Wood for Surgical Splints

A NEW kind of surgical splint in which galvanized wire-netting takes the place of wood, has been put on the market. It has been tried and offers many advantages. The steel entering into the construction of this woven wire splint is so tempered that it can be molded by hand. Being galvanized, the wire is sterilized and at the same time welded into a single piece that cannot fray out at loose ends. As it is porous, it allows a certain amount of evaporation and air circulation to the dressings beneath, which wood or plaster does not. The splint comes rolled like a bandage and is lighter and less bulky than wooden splints.



Two metnods of using the wire netting splint are shown in the illustration

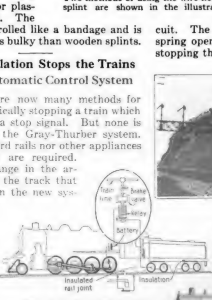
Track Insulation Stops the Trains in This Automatic Control System

THERE are now many methods for automatically stopping a train which has run past a stop signal. But none is simpler than the Gray-Thurber system. No ramps, third rails nor other appliances on the track are required. The only change in the arrangement of the track that is necessary in the new system is a single piece of insulation, placed at the rail joints near the semaphore signals.

Between the insulated rail ends at these joints is a make-and-break relay operated by the same current as the semaphore. In case of danger, the breaking of this current raises the semaphore arm to the "stop" position and, at the same time, it opens the relay. The two rail ends are therefore electrically disconnected from each other.

The valve controlling the brake is normally held inoperative when there is a current going through the valve relay. This current flows from a battery on the locomotive, through the locomotive wheels, the rails, the wheels of the tender, and from thence to the relay. But when the train passes a danger signal, the disconnected rails break this circuit. The relay is demagnetized and a spring opens the valve of the air brakes, stopping the train.

When the semaphore arm goes up, the track relay opens. Should the train try to pass the disconnected rails, the valve relay is demagnetized and the brakes are set



The circle shows the location of the valve relay which sets the brakes on the train when its current is shut off

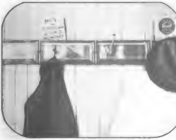
Glasses That You Can Wear In Comfort

PERSONS who are compelled to wear eye glasses know that, as a rule, the frames are either too tight and make the nose sore or so loose that they will not stay on. A Western surgeon thinks he has invented a frame that will do away with pain and profanity at a stroke. Instead of suspending the spectacles by the bridge of your nose only, he has arranged springed extensions ending in small plates that catch the face just above the eye at a spot where they escape a vital nerve or blood vessel This little device holds the glasses firmly in place and relieves most of the pressure on the nose, and at the same time it allows the glasses to be removed easily with one hand.

Simple and effective is this device for giving a firm grip to eyeglasses without nose-pressure

Coat Racks Display Advertising When Coats are Hung

A COAT rack which turns up an advertising card automatically whenever a hat or coat is hung on one of the hooks is now being marketed by a Western novelty concern. The advertising cards fold down into a small box like structure whenever the weight is taken off the hooks. When a coat, hat, or other garment is hung on one of the hooks, the hook is pulled down about four inches, and the advertising card is turned up into view. Naturally the attention of the person hanging up his garment is attracted to the add. This advertising novelty is now being placed in numerous restaurants, and other pubic places.



An "ad" pops up as the hook goes down by the weight of the coat or hat

Allies Restrict Use of Gasoline

IN all the belligerent countries of Europe there is a great scarcity of gasoline, and everywhere the most stringent laws for restricting its use for the running of automobiles have been passed. Touring for pleasure has practically been stopped. In England, some success has been achieved in running cars by coal gas carried in bags on the roof of the cars, but in Italy, with coal at $200 a ton, this substitute is impossible. The price of gasoline is $2 a gallon, when it can be obtained. Somewhat better are the conditions in France, where gasoline may be purchased at $1 a gallon.

Switzerland is feeling the gasoline famine even more seriously than the belligerent nations, stock being so low that all private use of automobiles has ceased. Reports regarding Germany, coming through Switzerland, are to the effect that there is no gasoline shortage for army use, but the lack of rubber is causing serious trouble.

Mike Has a Nose of Brass, But He Should Worry

IT IS being demonstrated to the folks of Mt. Healthy, Ohio, by old Mike, the faithful horse of the street-cleaning department, that a real nose is quite a superfluous thing.

Now if Mike had relied on his own natural nose he would have been dead long ere this.

When Mike's nose ceased to work properly some five years ago, and it seemed that Mike would die of suffocation, Joe Stoppel, his owner, said it would be a shame to let a nice horse like Mike go to the dogs merely because he hadn't the use of his nose.

This horse breathes through his neck. The small brass disk indicates the spot

So Stoppel consulted a horse doctor who told Stoppel to cease grieving, because he, the doctor, could give Mike a new nose by way of his neck.

The doctor made a hole in Mike's neck and opened the windpipe and put a tube into it. At the outer end of the tube he fastened a brass disk which may be seen in the picture.

All the air Mike breathes goes through the disk, up the tube and down Mike's windpipe. On cold days Mike's brass nose even emits steam.

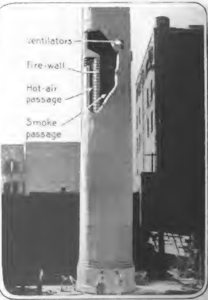
"And he's better'n ever now," says Stoppel. "Giddap Mike."

Carrying Off Smoke and Foul Air in the Same Smokestack

A DOUBLE-WALLED stack, which acts as a combined ventilator and smokestack, has been built in Los Angeles, California. The foul and hot air from the engine room enters at the bottom of the stack, passes up through a space between the outside concrete wall and an inner firebrick wall and out of ventilators. These ventilators resemble windows and are placed about half-way up the stack, at which point the ventilating section of the stack terminates.

In contracting the stack from a diameter of ten feet, six inches at the base to six feet, ten inches at the top, the sections were tapered in a novel manner. In the form were a number of tapering slats. The sections were made smaller and smaller by removing one slat from the form each time a section was laid.

The engine room likes the improvement. Almost always engine rooms are the most poorly ventilated regions in a whole building. We anticipate there'll be a big rush of engineers to Los Angeles, now that we've published this article.



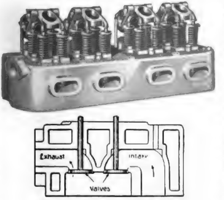
A double-walled smoke-stack with an inner compartment for smoke and an outer compartment for hot and foul air

Fifty-Seven Miles an Hour in a Ford!

ANY owner of an automobile with a detachable head motor—such as a Ford has—may increase the speed of his car from fifty to sixty per cent by means of a sixteen-valve-in-the-head cylinder attachment, shown in the accompanying illustrations. As much as fifty-seven miles an hour have been reached with a Ford.

No machine work is necessary to install the attachment. Although sixteen valves instead of eight are employed on the four-cylinder engine, the same valve push-rods are used. This is made possible by an ingenious lever arrangement on the top of the head. All the channels previously used for intake and exhaust are converted into intake passages alone; the area for the incoming gases is doubled and similarly those for the exhaust. By reason of this increase, and by placing the spark plug directly in the passage over the piston head instead of off to one side, as in the regular Ford L-head engine, the larger volume of gas is more quickly ignited and more thoroughly burned. Similarly, the burned gases are instantly released with but a very small back pressure, so that they are completely expelled before the admission of the next incoming charge.

Just how efficient such an attachment is, is not stated. Probably, it is chiefly of use on racing cars. Usually where gases are shot in and out of cylinders so rapidly a waste ensues. Wear on parts is also greater. Imagine a little Ford scrambling down a race track, this new attachment on its engine! From under its hood comes a roar, the wheels whir, the fenders clatter, sundry parts threaten to leave themselves along the right-of-way. "Too much is enough," groans the Ford.



Showing exterior and details of the new sixteen-valve-in-head attachment for Ford motors


The physician has his hands free for the examination of his patient's mouth or eyes

He Holds the Light So That the Hands Are Free

SOMETIMES a doctor must examine the mouth, the throat, or the eyes in order to make a correct diagnosis. The ordinary electric pocket light is not convenient because in using it the doctor does not have the free use of his hands. Dr. Alfred Kahn, of New York University, has invented an ingenious light which the physician may hold in his mouth. The simple construction of this light, its triple ball bearings, its lightness of weight, and the fact that it can be bent around one finger or held by the fiber mouthpiece between the operator's teeth make it extremely useful to the general practitioner. Another advantage of the Kahn light is that it may be perfectly sterilized. Doctors especially like a lamp of this kind for emergency calls.

Safety-First in Mine-Sweeping

How it is secured with a recently invented Swedish under-water kite

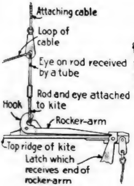
The dangerous occupation of sweeping the sea for mines charged with from four hundred to nine hundred pounds of T. N. T. has been rendered less hazardous by the invention of an under-water kite which first gently touches a mine and signals to the officers on board the ship

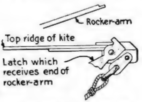
DRAGGING the sea for mines, charged with from four hundred to nine hundred pounds of T. N. T. and liable to explode when a little glass tube of acid is broken, is probably the most dangerous occupation in which a brave man can engage. It has not even the redeeming feature of being romantically interesting. There is no chance to fight—only the chance to die an instantaneous death.

As might be supposed, the mine-sweeper drags the waters of the sea with a cable. But the cable alone is not enough. An auxiliary signaling device is also found necessary, something which will indicate the presence of a mine before the actual dragging begins. To this end, a Swedish tell-tale, recently invented, is employed in nearly every navy and particularly in the German navy.

The Under-Water Kite and How It Works
Beneath the roof-shaped kite, an arrow-shaped control is suspended by three small wires. When the two forward wires of the arrow-shaped control release a latch by which the attaching cable is secured to the kite, a bell is rung on board the ship, indicating that the entire apparatus has come in contact with a mine to be removed.

The tell-tale may be described in a general way as an under-water kite which is dragged by means of a steel cable which is paid out from a drum on the stern of a vessel. As the ac-





Releasing Mechanism of the Under-Water Kite
The hook of a rocker arm enters an eye in the end of a rod suspended from the attaching cable of the kite. When the arrow-shaped control strikes a mine, the latch by which the end of the rocker arm is held in place is released. Hence the hook is withdrawn from its eye and the attaching cable freed from the kite so that the kite is suspended only by the loop of cable. The sudden slackening of tension on the cable causes the bell on the ship to ring.

companying illustrations show, this under-water kite consists of two pieces of sheet metal joined together in the form of a common barn roof. Suspended below the under-water kite by three ropes, is an arrow-shaped control which is guided by a roof-shaped piece. If the arrow-shaped control should touch a mine, a latch by which the under-water kite is attached to its cable is released, a bell is rung on board the mine-sweeping vessel, and the officer in charge is at once warned that the tell-tale below is in contact with a mine to be removed. Very slowly and very carefully the vessel approaches the mine, raises it to the surface and then steams away again to a safe distance. Thereupon the mine becomes a mark for the gunners until it explodes, tossing to a height of three hundred feet, a great geyser of water. So terrible is the explosion that the effect is felt in the water within a quarter of a mile.

The fire-escape elevator is nothing more than the cornice of the building, raised and lowered in the same manner as an elevator

In Case of Fire, Take the Cornice Elevator

When a fire occurs, why not use a cornice elevator instead of the usual fire-escape? Extending the entire width of the building, it could be lowered floor by floor, permitting persons to enter it through every window. Furthermore, a burning building could be emptied in one-half the time, and after the cornice elevator had discharged its human freight, it could be used by the firemen as a movable platform from which to fight the flames.

Such are the uses to which the fire-escape elevator may be put, according to the inventor, Bernhard Sussis, of New York City. In its usual position, it serves as the cornice of the building. The hoisting and lowering machinery which consists of steel cables and drums and an electric motor is all situated on the roof. The elevator is operated from a control-ling lever on the platform, moving up and down against an upright pair of rack-bars attached to the side of the building. It is equipped with guard-rails, side-chains and steps. As shown in the illustration, it looks almost too ideal to be practical.

The Graveyard of Automobiles

How much is an automobile worth, not as a vehicle but as so much metal, hair, rubber and wood? The "junkie" knows.

SOME makes of cars have a large proportion of the rarer metals concealed within them; some have starting and lighting systems; some have magnetos; and some nothing. The "junkie" knows just what a rumbling scrap-heap is worth.

Rubber tires and other rubber parts are valuable and are kept in separate piles

Hair from the cushions sells for fifteen cents a pound at present prices. Copper is worth twenty cents; aluminum twenty-two cents for cast, and thirty-five cents for sheet. Some cars do not have these ingredients; they are on the junkie blacklist. Lead comes chiefly from electrics, brass runs from fifty to one hundred pounds per car, aluminum from fifty to two hundred pounds and hair about twenty. "Iron," which includes all the alloys that look like iron, sells for only twenty-five cents a hundred pounds; their finer divisions into bearings, vanadium steel and other classifications the junkie leaves to the buyer.

The junkie can tell you how many pounds of aluminum, hair and copper there should be in a 1906 Packard. He knows where he can use unbroken parts and he often has a standing order for certain parts of certain cars. These he is of course careful about.

In a well regulated junk shop the automobiles which have outlived their usefulness are dismembered and the most valuable parts sorted out and placed in separate piles or compartments. Wheels, tires, lamps, upholstered parts, glass, etc., go to their respective storage places, where they await their resurrection or transformation, as the case may be. Only such parts as are hopelessly irre-

f the machines which supplied the component fragments of this chaotic
teresting and perhaps sensational reading. There is nothing pleasing

deemable are cast out upon the scrap heap or dump.

This general scrap pile, with its mass of broken and twisted chassis frames, axles, motors, wheels and what not, does not present a beautiful or cheerful picture. It is as a battlefield after a terrific battle, covered with the victims of the struggle. To think of the past glory of the racers and roadsters, limousines and runabouts, the dismembered parts of which now lie in a confused mass, rusting and rotting in every kind of weather, might inspire a poet to write an "Elegy of the Scrap Pile."

Upholstered parts contain horsehair, wool and other valuable material which may be used again

As a result of the higher prices paid for metals during the last year, there are now many junk organizations which buy a car too old to run or just able to wheeze, for from fifty to two hundred dollars, with no intention of ever letting the machine run another yard. By the time the parts are melted up you may find some of your old car in that new one you just bought.

mass of broken and tangled metal about the sight presented by this junk

The Open Grate Fires We Love Are Very Wasteful

THERE is something so cheerful and companionable in an open grate fire that even prosaic folk succumb to its charm. For many centuries, the open hearth or grate was the only means of heating dwellings during the inclement season, but times and conditions have changed and to-day grate fires are not taken seriously as a heating method. They still survive in that capacity in the somnolent backwoods and are preserved for ornamental or sentimental purposes even in modern apartments. But they have outlived their usefulness, and are doomed like other institutions of a remote past that do not fit into present conditions.

From a sentimental point of view open grate fires may be desirable, but practical and economical business sense must condemn them as the most wasteful and inefficient method of heating. This would hold true even under more favorable conditions, but in the present day, when the most stringent economy of fuel is obligatory, the continuance of open grate fires for the purpose of heating would mean criminal wastefulness.

Into the grate one puts fuel that has the power of producing a great deal of heat, but the useful heat obtained from the fuel by that method is extremely small. Most of the warmth produced goes up the chimney, with a large quantity of air from the room. This air is replaced by cold air drawn in through the cracks in the windward side of the house. Such a method of ventilating is altogether too expensive and wasteful. A stove would be far more economical, and to-day economy is the first consideration.

Deep-Sea Fish with Lanterns

Some fish carry their own power plants, searchlights, lenses and dimmers as if they were living automobiles

By Dr. E. Bade

Illustrations by the Author, supplied by Courtesy of American Museum of Natural History

DEEP-SEA fish have been strangely influenced by that total darkness in which they live. Their eyes have lost their responsiveness to light and are therefore practically sightless. These blind fish are the inhabitants of those profound depths into which not even an infinitesimal ray of light can penetrate. In fact the fish must live in perpetual darkness. The eyes of some deep-sea fish are tiny; the eyes of others are very large and round, as if they would catch some faint ray which may by some chance have penetrated these depths. But the most peculiar thing about the deep-sea fish is that approximately one fifth of them have developed some kind of a luminous organ, carried on this or that part of the body. Yes, even the whole body of some of the fish is illuminated, giving off to the surrounding water a faint iridescence as they glide along.

Some deep-sea fish are equipped with headlights which look very much like those on an automobile

It's Deep Where They Live

Such lights are found not only on deep-sea fish, but on some varieties that live in well-lighted parts of the ocean as well. Two small varieties, commonly called "lantern fish," inhabit the Malay archipelago about the Banda Islands. A third variety has recently been discovered near Jamaica. These three forms are the only ones upon whom the action of the organ of light can be observed under normal conditions. The large, luminous organ, situated just below the eye, emits a greenish-white light, which is not steady but which flickers rhythmically. By pushing or pulling a skin over this organ the fish prevents all rays from escaping outward.

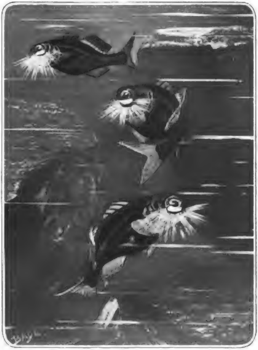
The light-organs of deep-sea fish are similar in structure. They were in all

Other deep-sea fish have their bulbs, resembling portable electric lamps, attached to the tip of a long, movable stem

probability developed in zones of semi-darkness.

Glands Furnish Light

It makes no difference where these lamps may be found or on what part of the body they may be carried. All are evolved from glands. In its simplest form the gland is a sack, the walls of which give off a luminous substance which is ignited when it comes in contact with the water. The action is therefore chemical. On the other hand, some fish have an inclosed organ which is lighted up within the body. The construction of the organ is very complicated. First, there is a covering which prevents the light from entering the body. In front of this is a silvered or brightly colored reflector which acts as a searchlight, in that it tends to throw the light outward. Often there is a lens present to concentrate the light, thus making it seem much brighter. Besides all this, many fish have dimmers which can be used at will, so that they can prevent light from escaping outward.



A fish with fish "lamps" beneath the eyes. These eyes are large and round, but apparently almost sightless

They Look Like Moving Signs

In addition to the principal organ of light, many deep-sea fish have minor ones, often arranged symmetrically, forming many beautiful patterns which emit a varied colored light. The purpose of these is in all probability to distinguish one variety of fish from another and male from female. But the use of those organs of light which have reflectors, lenses and dimmers, can only be conjectured. Some are, undoubtedly, real lanterns used to illuminate dark surroundings; others, which are attached to the tip of a long, movable stem, and carried not at all unlike an electric bulb, may be used as decoys to lure in unwary prey; other organs again are of a protective nature, lighting up when the fish is attacked. All these organs emit a perfectly cold light—something that man has not yet invented.

This fish is decorated along its whole length with lamps, which flash and dim like an electric sign which bids for notice

Housekeeping Made Easy

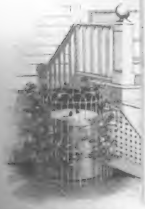
Novel twine-ball holder made of wood. The muff, of course, is the ball

A locking device that holds the window-sash wherever it is set. It keeps out burglars or lets in sufficient air

Flusher which connects the faucet and sink opening to force out obstructions in drain

A pencil-case which will please the children. When closed, it looks like a book, and it can be conveniently carried to and from school

At right: A kitchen cabinet with a large flour bin which can be lowered and raised automatically



Ornamental guard for a garbage can. It hides the [illegible] it is dog-proof

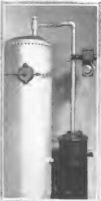
Built-in telephone closet. Keeps out dust and saves space

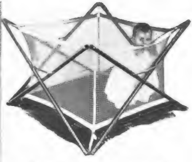
A catch-drip for the radiator vent. It also humidifies the rooms

An ornamental cover for a drinking glass which is used in the guest-room

Housekeeping Made Easy

New feed-through switch which can be attached to the flexible cord of an electric iron or other small electrical apparatus





A play-yard that provides ample room for the baby. It can be folded away in a small space

Alarm for the hot-water boiler. A bell rings when the temperature reaches the desired heat

This new cedar chiffonier replaces the old fashioned cedar chest

Below: A rotating cutter for fruit and vegetables. It slices them evenly

With this adjustable castor a table cannot possibly tip

Handle with a renewable wick, for greasing griddles, cake pans and muffin tins

Folding bed on a narrow truck fits into a small closet

Furnace ashes are pushed into a can at the back of the pit

What About Potash?

Talk about coal! Why, potash costs $450 a ton and hard to get at that

THE farmers of the United States and of other countries are dependent on Germany for cheap potash. Germany's famous potash beds are unique. These salt beds constitute an important geologic formation, for there are no other similar deposits in all the earth, and potash is indispensable to agriculture and industry.

In 1913, the year before the war, these mines produced close to 12,000,000 tons of crude potash salts, an amount sufficient to build a pyramid nearly twice the size of the famous pyramid of Cheops. At that time, this industry employed 2,200 officers and 40,000 laborers. It used 1,600 boilers, running 2,200 steam engines and developing 220,000 horse-power. The average daily output was 3,670 carloads of 10 tons each. A fleet of 258 ships, each carrying 4,000 tons, was required to transport the 1,032,127 tons of potash salts used in the United States in 1913.

The greatest chemical need of this country today is for potash. Besides being indispensable to growing crops, it has a multitude of uses in the arts and industries. It is essential to the manufacture of munitions, glass, matches, baking-powders, drugs, dye-stuffs, soap, antiseptics, and many other articles. Potash salts are used in the purification of water for municipal and industrial uses, in the metallurgy of gold, electroplating, processes of refrigeration and the commercial production of hydrogen for the inflation of balloons and Zeppelins. Photographers use it, so do painters, bleachers, weavers, dyers, paper makers, chemists, and many other artisans. Without caustic potash, Edison's famous storage cell would be impossible.

The known sources of potash in this country are pitifully small in comparison with the needs. The total of the much heralded supply in Searles Lake, California, will not exceed the output of the German mines

All the comforts of home! Eating lunch far underground in a potash mine somewhere in Germany

Hard at work. Germany's potash mines produce annually twelve million tons of crude ore, 40% pure

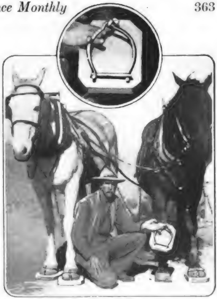
for a single year. Besides, the water of this lake contains, in solution, borax as well as potash, and the separation of the two salts is not simple. Borax, being alkaline, renders potash objectionable to agriculture and useless in industries. There are a few other sources of potash. Sea-kelp yields a small amount; the alunite deposits in Utah contain potash salts of alumina, but no soluble potash; the cement works are producing a little; some is contained in the refuse from the beet sugar refineries; but outside of Germany, the total annual output of potash is not over 50,000 tons as against 12,000,000 tons of the crude ore running from 30 to 40 per cent. of pure potash, produced in Germany each year. Since the embargo of January, 1915, the price of potash has risen from $30 per ton to $450 for the same amount.

A Gasoline Engine Used to Load Sugar Cane

THE old problem of handling a large sugar-cane crop soon after it has been cut, and before the cane dries and its sugar evaporates, has been well solved on a Louisiana plantation. A gasoline engine power outfit is utilized for this work and does it at a fraction of the cost of man labor, and more quickly.

Suitable grabs and hoists pick up the cane from the small heaps into which the cutters have dropped it, and swing it over to be tripped off into a wagon box. The wagons are provided with slings to unload the cane at the mill or at the field railway by the use of power hoists. Power machinery is much slower to invade the agricultural regions of the South than it has been in the North. But the waste and inefficiency of hand methods must give way before the present need for rapid harvests.

Suitable hoists lift the fresh sugar cane from the small heaps and swing it into the waiting wagon



If it weren't for these boards the horses would sink into the peat quagmires of southern California

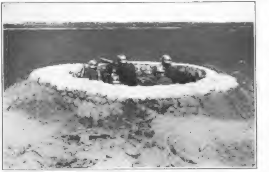
Mount Horses on Boards. Then they Can't Sink Into the Mud

OUT in the fertile peat fields of southern California, the heavy draft-horse would be useless for plowing and cultivating, but for a wooden shoe, which was invented by some ingenious rancher, and which can be quickly clamped on the horses' hoofs. With his wooden shoes, the horse can walk safely on a surface of peat that quivers like jelly with his weight.

The shoes must be adjusted to suit the habit of the horse. If he has a tendency to knock his feet together, they must be trimmed off on the sides, although it is obviously best to have them as wide as possible. They are clamped on by means of small iron rods, curved to fit the hoof.

Let 'Em Come—This Outpost Will Account for Itself

IT is innocent-looking country, isn't it—that shown in the illustration on the right? Might be New Jersey flats, or a section of Northern Indiana, or a piece of Middle-western prairie. Yet a few hundred yards off toward the horizon are the enemy lines, and the Germans are in them. The country isn't as benevolent-looking or as calm and peaceful as it seems. Such outposts as this may soon be occupied by our boys in great number. Because the country is flat, a machine gun is effective over a wide area.



© Kadel and Herbert

A French outpost close to the German lines. Mud-soaked sandbags form the low parapet

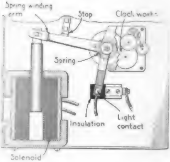
Weep No More, Landladies. The Light-Wasting Roomer Is Checked

THE reason landladies are wary about having lights in the halls is, of course, that it costs money to burn lights. Now John H. Jordan, of Scranton, Pa., would come to the rescue. Landladies need worry no longer about what the meter is doing. Moreover roomers may have light any time they want it.

The how of his plan is this. The contrivance consists in part of an electromagnet connected in series with a push-button lamp-switch. When the roomer comes in and pushes the button, this electromagnet pulls down a lever. The lever winds up a coil spring. The coil spring runs a clockwork. The clockwork runs until the spring is unwound again, meanwhile permitting the lever slowly to move back to its old position. This takes about three minutes, and during that interval a switch, mounted at the lower end of the lever, has been "on." This switch caused the electric lights to light, and the three-minute interval they stay lit is sufficient for the roomer to get upstairs or wherever else he is going. Simple, isn't it? The landlady knows that the roomer will have to get up at three-minute intervals and punch that switch if the hall light stays lighted permanently. This is unlikely. Therefore she rests in peace.

The contrivance may may be applied equally well to attic or basement lights. Forgetting to turn these off is a common habit and a machine that will do it automatically saves on the monthly lighting bill. Closets and storerooms also need the device.

No longer need the roomer come in and fumble for the socket this way. He simply pushes a button in the wall. The lamp is lighted for just three minutes. The push button energizes the solenoid. It pulls down the core, winding the spring, closing the lamp circuit. It later opens



Fighting Off Aviators with Shotguns

The sawed-off shotgun of the under world is gaining laurels in a new field

UNCLE SAM has decided that the shotgun is, under some conditions, as deadly as the machine gun, and his Chief Signal Officer has ordered that instruction in the use of the shotgun be given at every one of the sixteen aviation schools now running, or about to be established.

When war started, the aviator used to go up merely to scout. He took along a rifle and a revolver or automatic pistol. But he could do no harm with such weapons in an aerial combat.

Then came the light machine gun, and the start of real aerial warfare. Now the air fight is merely part of the game, nor is the report of the week's doings complete without mention of the fact that the side making the report lost three planes and the other fellows thirty.

What a Shotgun Will Do

At ninety feet all but one of the pellets bunched themselves well into the midriff section of a man-size figure fired at. At one hundred and fifty feet, seven out of the twelve hit the figure. At three hundred feet one shot missed the figure, two other shots put two pellets each into the figure, which is a disabling blow.

Also, there is the fast increasing use of the plane in sudden swoops over the enemy trenches; the machines, although they fly low, travel so fast that they cannot be hit with any certainty. Here, at short range, the five shots from the automatic shotgun would prove more efficient than charges from the machine gun, because the machine gun fire is concentrated while the buckshot scatters. And of course, there is also the use of the shotgun against the opposing plane at close quarters, where the action is too fast for swinging the machine gun to bear.

Buckshot varies in size from the tiny pellet running twenty-seven to the ounce of weight, to the sort running only nine to the ounce. Usually but an ounce of shot is loaded for the 12-bore gun, and the powder charge is three and a fourth drams.

For use against men at short range—less than fifty yards—the small size would be indicated. While it might not prove fatal in most instances, a few loads of this sort of pill would put the recipients in the hospital.

Number One Buck is just the size of the army bullet, .30 inch across, and weighs forty grains per pellet. Twelve pellets make an ounce and therefore the load.

The big, single, round bullet used in shotguns is another sort of missile that might well prove efficient in the hands of our aviators. Nothing shot out of a military rifle—outside of the rifle grenade—gives the tremendous shock and blow of the big .70 calibre, five hundred grain, round lead bullet that is used in the 12-gage shotgun. More than twice the size of the service rifle .30 calibre bullet, more than three times as heavy, and with a tendency to flatten out and hit still harder, the single ball for the shotgun, while not high in accuracy, is capable of knocking a man flat on his back if it hits him fairly. Five such huge pills, slung rapidly into an opposing aircraft, at a range of one hundred yards or less, would be like throwing five half-bricks into the machine with the velocity a half-brick never attained in this world.

A party which was persuaded to go joy-riding through a coal mine in a Ford. The trip was a great success

What Won't a Ford Do If Properly Coaxed?

THE Ford's latest performance is turning mole and going grubbing in a coal mine. Dr. David Roy Nelson was the pioneer who coaxed his car into the Monarch Mine, at Monarch, Wyoming, and then had it photographed standing in the "Great Black Way."

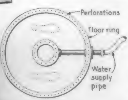
When Your Clothes Catch Fire

KEENLY realizing and sympathizing with the world-wide demand for some really efficient but simple fire-extinguishing apparatus which can be placed within reach of people who carelessly allow their clothing to come in contact with flame, Ja[illegible] O'Loughlin [illegible] devised [illegible] ented [illegible] ra[illegible] testimonials from highly satisfied and more or less scorched customers.

The apparatus consists of three hollow perforated rings, connected by means of a flexible hose to a convenient kitchen faucet. To the smaller ring is fastened an asbestos curtain or garment and hood which is intended to envelop the body. The entire apparatus is collapsible, and when not in use is stored away in a cabinet fastened to the kitchen wall.

Here is the advice that Mr. O'Loughlin would have you follow when your clothes catch fire:

Go at once to the extinguisher cabinet. Pay no attention to your burning garment. In fact let it burn with impunity. If you have time, sneer at the flames in contempt! Press the release button of the cabinet. The doors open. Remove the perforated rings. This automatically starts the flow of water. Place the large ring on the floor with its perforations facing upward. This is very important. Stand yourself in the center of the ring. Whatever the flames have been doing in the meantime does not matter. This invention is not concerned with the action of fire, but only with the method of extinguishing it. It is important to keep your mind on the task at hand; otherwise you may find it necessary to allow the fire to burn itself out, which would not be quite as enjoyable as bathing it out.

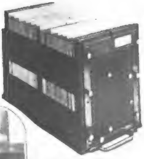


[illegible] connect [illegible] faucet

The smaller ring to which is attached the hood and cloak is thrust over the head and to rests on the shoulders. The cloak now unfurls and drops over the ring on the floor.

Selecting Men Made Easy

Here is a self-thinking file that picks those wanted automatically

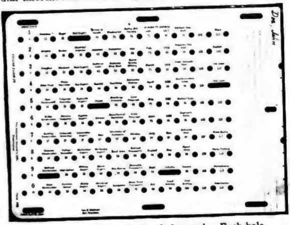


The file case does not differ in appearance from the ordinary kind

Above is shown the front of the file case with rods inserted for making a selection

THE experience of England and France early in the war clearly proved the importance of keeping a detailed and intelligently indexed record of every man in the army and navy and their auxiliary branches. It also showed the need of a system that would make the grouping of the men, according to certain qualifications, a simple, possibly automatic, process.

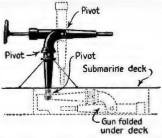
Such a system is offered by a file called the Findex, which promises to save the American government from the difficulties experienced by her allies. The device consists of a file case containing rectangular index cards. These cards have a space for the name of the soldier at the top, while in the lower part there is a system of round holes, arranged in horizontal and vertical rows. Each hole represents some particular information concerning the subject of the card, which it may be desirable to put on record. The items represented by such holes include for instance the previous civilian occupation, military experience, knowledge of languages or expertness in some profession or trade. To indicate that the subject of the card possesses a certain qualification, the space between the holes corresponding with the respective index number is punched out, thus making an oblong slot.



This is a reproduction of an index card. Each hole represents a detail of information about some soldier

Suppose that the Government wanted to select a corps of railroad engineers. A clerk inserts five rods through holes in the front of the case, numbered to correspond with the holes in the cards, indicating the particular qualifications desired. Then the whole file, case and all, is turned upside down on the table. All of the cards not having the slots to indicate the possession of the required qualification by the subject of the card will be held in place, while the slotted cards will drop down and can quickly be removed from the file.

This modern submarine has a disappearing gun which folds away below deck



Detail showing how neatly and compactly the gun and its support are packed under deck

A Gun Which Will Lie Down

THE submarine has been a defensive weapon in most navies. Apparently the Germans were the first to realize that it had offensive possibilities. We found a patent the other day applied for in the United States, by Julius Becker, an employee of the Krupps. It proves our point.

It is interesting to note that the patent was applied for in 1909, showing that even then Germany was awake to the uses of the submarine as an offensive weapon.

A hollowed-out compartment on the deck of the boat receives the gun. The gun barrel is mounted on a pivot fork, turned toward the muzzle, so that when not in use, the gun can be folded down horizontally. The pivot support also folds down, coming either over or under the barrel of the gun. Four removable rods, which are joined to the platform, support the gun ...

A pipe ... to the ... overfl... is i...

... little of the limited space on a submarine, and thus low-lying and protected by a water-proof cover, it offers no resistance to the submerged travel of the boat. In other words, Becker boldly attacked the problem of arming a submarine with a weapon which could be raised or lowered at will, as the vessel came to the surface or submerged.

Magnetized Birds? Another Explanation of Accurate Migratory Flight

ONE of the many explanations that have been offered to account for the fact that migrating birds are able to find their way by night and in cloudy or foggy weather is that they are sensitive, in some way, to currents of terrestrial magnetism, and therefore direct their flight by the magnetic meridians. This suggestion was put forth by M. A. Thauziès, a French pigeon-fancier, who declares that carrier-pigeons make poor flights during the occurrence of magnetic storms. He also asserts that the general use of wireless telegraphy has diminished the reliability of these birds to a surprising extent.

...ring, invention form a kind of guild. We ... of the POPULAR SCIENCE MONTHLY is

Don't Throw Away Waste Paper. Bale It!

EVERY household, every school, store or public building is everlastingly confronted with the problem of how best to dispose of the accumulations of waste paper, newspapers, paper bags and wrapping paper. To destroy paper stock is a great waste of money as the price of paper is extremely high.

William J. Palm, of Minneapolis, has invented and placed upon the market a simple contrivance which offers an inexpensive and adequate solution of the waste paper problem. The invention consists of a stout box, open at the top and with a hinged front. The back and the movable front of the box have each, on the inside, two ratchet bands into which engage the pawls of the sliding press-plate. The paper is deposited in the box which rests on strong swivel-rollers and is pressed down by the top plate. When the compact bale of paper thus formed has reached the desired size, the front of the box is let down and the top plate removed, which facilitates the tying up and removal of the bale.

A baling contrivance which will enable you to save waste paper

© Int. Film Serv.

The thermometer registers ten below zero. But they take their dip just the same—Br-r-r!

The Human Polar Bears. They Bathe in Icy Water—Br-r-r.

DURING the bathing season many thousands enjoy the cooling surf at Coney Island every day, but when the winter brings zero temperature and icy blasts from the north, and big ice stalactites form on the piers and on the lower side of the board-walk, Coney is almost deserted. Only a small group of hardy men, who fittingly call themselves Polar Bears, remain true to Father Atlantic and daily disport themselves, clad in their bathing suits, upon the icy beach and amid the floating ice in the ocean.

The accompanying picture was taken at Coney Island on one of the coldest days of the winter. The thermometer registered ten below zero and the photographer was nearly frozen while taking the picture. Well, after all it is but a matter of constitution, inclination and habit. The Polar Bears really seem to enjoy their icy winter bathing.

Learning to Duel in the Sky

How the towed target balloon is used in machine-gun practice

By Lieutenant Henry A. Bruno

Late Imperial Royal Flying Corps, Canada

A FEW weeks after America entered the war plans were made for the immediate training of thousands of air-fighters. Some of the best army men in the United States service were sent to Canada to find out something about the science of training men for aerial warfare.

The largest aerial gunnery school in Canada is the one at the Royal Flying Corps Headquarters, Camp Borden, Ontario. To-day there are several gunnery schools in this country modeled after Camp Borden, and the methods used in the United States are slight improvements over those adopted by Canada.

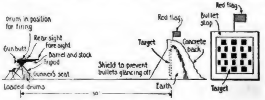
It is at the ground school that the prospective air-fighter first makes the acquaintance of a machine-gun. In order to graduate from the machine-gun division of the ground school he must be able to take down and assemble both the Lewis and Vickers guns.

Firing, with trench machine-guns, at large targets placed in gun-pits, is the first actual firing done by the pupils.

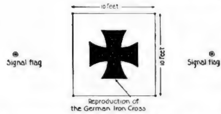
After receiving Q. V. G. ("Qualified Very Good") on this ground gun work, the pilot takes his first actual lesson in aerial gunnery. A standard Curtis, two seater, ninety horsepower training biplane is used, altered so as to allow a gun to be fitted. The target, a square of white canvas bearing a reproduction of the German iron cross in the center, is laid out on the ground. Two signal flags are raised to warn the curious away.

You climb into the plane, and strap yourself tightly in your seat. As the gun (an eighteen-pound Lewis) will move up and down only about ten inches, the only way to get a shot at the target is to have the pilot shut off his motor and dive nose first to within a few feet of it. Then you grind out your shots and swoop up again. If your pilot doesn't open up his motor and swoop up in time, you crash. If you fire at too long a range the instructor will call your attention in no gentle way. If your pilot shows fear in not getting close enough to the target, both of you will get a worse reprimand than if you were to smash several machines.

About a week later you will be ready for advanced air practice. This time the target is a pear-shaped



The target, fifty feet from the gun, consists of white canvas with black squares painted on it



Appearance of the target, at which the flyer directs his fire, as his aeroplane dives down

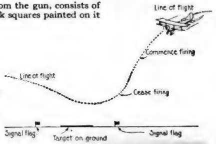


Diagram showing the line of flight in practice and marking the proper position for firing

How Dueling in the Air Is Taught

balloon which bears the Iron Cross or some other conspicuous sign and which is towed by another airplane. Your pilot waits until his plane has reached three thousand feet. Then, after a final examination of your gun and ammunition drums, you signal "O. K." and the chase begins.

Your pilot has maneuvered the plane so that you will pass under the other machine towing the target in the opposite direction. Nearer and nearer it comes, with the target flying on behind at the end of the long towline. With a roar the plane passes overhead. Into action you go—finger pressing the trigger and both arms holding the bucking ringsight on the target. In a few seconds it is all over. You look behind you and see the other plane flying serenely away. The target is undamaged. You have wasted a drumful of cartridges on the empty air. "Rotten," you say to yourself. Obedient to the control of your pilot the plane goes over in a loop. You come out of it pointed in the right direction and are off again after the elusive target. This time you are more careful. Your shots go home. With the shattered target flying in the wind, the hunted plane spirals to earth. A few minutes later you are on terra-firma again, receiving a report from your instructor on your exploits.

Baring the Super-Zeppelin's Secrets

What the French found when they examined the L-49 which fell into their hands after an air raid on England

By Carl Dienstbach

One of the control cars attached to a super-Zeppelin. Its functions are evident

IT was the oddest sort of an accident that preserved the L-49 intact for French inspection. She was one of a fleet of super-Zeppelins which had successfully eluded the airplanes and anti-aircraft guns of Great Britain, only to come to grief on French soil. She lost her way. Her gasoline supply exhausted, she was compelled to descend in the heart of France. True to his duty, her captain attempted to destroy her. He leveled the pistol which was to fire into her great hydrogen-filled envelope a flaming pellet, when he heard a shout:

"Hands up!"

He looked around and found himself gazing into the muzzle of a shotgun in the hands of Jules Boiteux, who had been out hunting. The crew had retired to a safe distance because of the conflagration that would follow the ignition of the gas. There was nothing left for it but to yield. And so a man with a shotgun captured one of Germany's latest super-Zeppelins and placed in the hands of the French Government military information almost priceless.

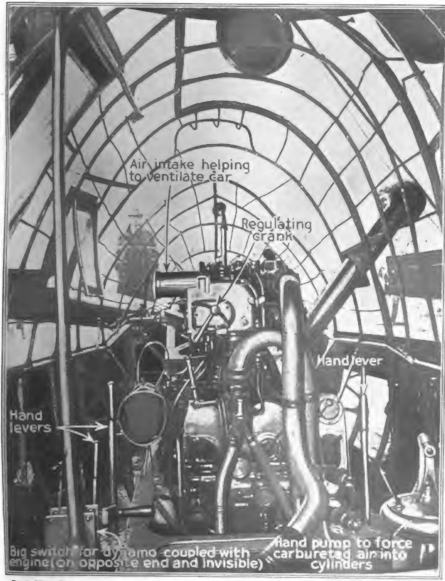
He did it with his little shotgun

How Fuel Was Sacrificed to Carry Bombs

Why was the L-49 forced to land? A super-Zeppelin has a radius of action and a bomb carrying capacity far exceeding that of any other type of aircraft. The experiences of the war have demonstrated that the dropping of a mere bomb or two is a futile proceeding. Literally tons of explosives must rain down from the sky to justify the risks of a bombing expedition. When airplanes set out to raid German towns they travel in scores—a fashion inaugurated by the French. Only thus is it possible to deliver a telling blow. Because of its enormous carrying capacity, a super-Zeppelin is in many respects a better bombing apparatus than a flock of airplanes. But the L-49 could not carry tons of explosives from Oldenburg to London without sacrificing some of her fuel-carrying capacity. Her fuel load had to be reduced to an unsafe minimum.

This juggling of loads also has its effect on the maneuvering power of a Zeppelin. It has been pointed out more than once in the pages of the POPULAR SCIENCE MONTHLY that a huge dirigible flies not only as an airship but also as an airplane. In other words, it is buoyed up not only by its gas, but also by the upward pressure of the air against its enormous surface. Indeed, were it not for the pressure of the air against its thousands of square feet of exposed area—a pressure comparable in every respect with that which keeps an airplane aloft—the giant rigid dirigible would be an impos-

Zeppelins Are All Ribs and Machinery

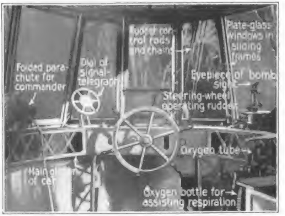


French Official Photo

Interior of a Zeppelin Engine Car

Now that the secrets of a Zeppelin's structure are completely bared to the Allies, the question arises whether it is not as difficult to succeed in running one of the machines as to build it. German officers say they would not mind giving the Allies a Zeppelin. They think only Germans could run it. The difficulties of getting the ships in and out of hangars, are very considerable

sibility. It is this air pressure which is relied upon to control the craft when the gas expands at great height and is dissipated, or when it shrinks in volume in a cold layer of the atmosphere, or when tons of weight are added by dew, rain, snow or sleet. Moreover, descending or ascending currents of air force the ship up or down, and these currents must be counteracted by flying the ship airplane-style.



© Kadel & Herbert

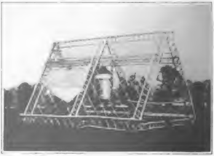
Interior of the commander's cabin, L-49. This was the directing head, and navigating center of the big craft

All this means that much is expected of the engines. The ship must be driven through the air at high speed if the most is to be made of the airplane effect. Since so much depends on mere motive power, the L-49 had been reduced to a huge cylinder of gas, a few cars for the crew, an enormous load of bombs, and the most powerful engines that air can support.

Wireless Signals from Germany Guide the Zeppelins

The passenger-carrying Zeppelins that plied over the Rhine before the war, had luxurious cabins. Fully three times as bulky as these ante-bellum vessels, the L-49 was nevertheless as bare of comforts as a racing automobile. She had been stripped of everything not absolutely necessary. For instance, she had only two machine guns; hence she was practically defenseless.

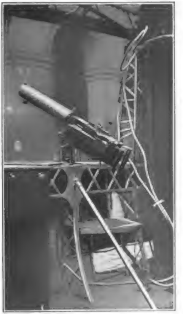
To the necessity of greatly reducing the amount of fuel so that an enormous quantity of bombs might be dropped on England, may be attributed the capture of the L-49 on French soil. Just how she lost her way, it is needless to explain here; the subject is discussed in the April issue of the Popular Science Monthly. It may be stated in passing, however, that Zeppelins are guided by wireless signals sent from German stations. The capture of the L-49 may be attributed either to those unexplained vagaries of wireless with which every amateur operator is familiar, or to ingenious radio deception on the part of the English or French. Of a fog-bound raiding squadron of a dozen or more ships, two returned safely on their regular course; six lost their way, drifted temporarily over France, luckily for them unobserved, and succeeded in stemming a frigid, violent northeasterly gale that had sprung up enough to regain German territory. The rest succumbed to attack and came to the end of their supplies in a gale which they had had to buffet with a limited amount of fuel. Rising to an altitude of 16,000 feet to escape shells and pursuing airplanes, they encountered an upper wind so violent that they drifted



© Kadel & Herbert

This is the triangular keel (part of it at least) from the ridge of which fuel tanks are hung like clothes from a wardrobe pole

farther and farther into France in spite of all their fuel-wasting efforts. One vessel had been ignited in the air by an anti-aircraft battery into the range of which it had blundered. One senselessly kept on fleeing until it was literally swallowed up by the Mediterranean. Two wisely landed and surrendered. One of them was the L-49 which was so oddly prevented from hiding its secret by self-destruction; the other was reduced to a mere mass of wreckage by its commander. A fifth, of uncertain idendity, is supposed to have gained Switzerland (possibly Friedrichshafen) in a damaged condition.

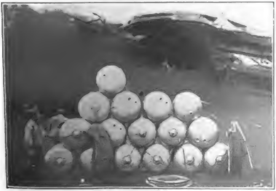


Machine-gun of the commander's cabin of the super-Zeppelin L-49

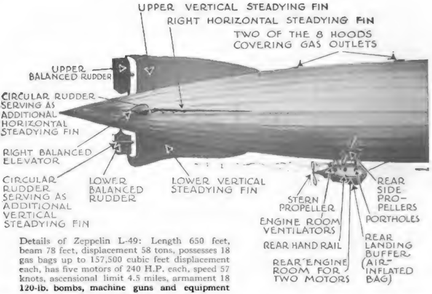
An Immense, Naked Hull of Perfect Form

The marvelous progress in design revealed by the L-49 is apparent to anyone who is at all familiar with the evolution of the Zeppelin. Her perfection lay in her simplicity. Speed is the life and soul of a Zeppelin—a speed that is never less than sixty miles an hour and may be as much as one hundred. Speed saves the Zeppelin from destruction in a gale. And speed has been obtained by trebling the size and by applying the lessons learned in developing the one-hundred-and-thirty-mile-an-hour fighting airplane.

In an airplane, it will be remembered, wires and struts are eliminated wherever possible; they offer too much resistance to the wind. The aviator is seated in a beautifully modeled boat-like body which parts the air with little disturbance, thanks to its streamline form. The rudders are as simple as possible. All the lessons which the war has taught the airplane designer have borne fruit in the L-49. There is the same inclosing of mechanical and structural parts, the same streamlining everywhere, the same simplification of rudders, the same reduction of surface and friction, the same disregard of mere bulk, provided it is correctly designed. As the drawing shows, the L-49 is but a naked, immense fish-shaped envelope of perfect stream-line form, with single monoplane fins and rudders, and with absolutely no appendages save four cars, each entirely enclosed and each torpedo-shaped. Only a rigid hull permits such ultra-refinement of form. Here we have another parallel with the development of the airplane. As the number and rigidity of the ribs in an airplane was increased, so all types of dirigibles have ceded their place to the Zeppelin despite opposition—all for perfectly good and practical reasons. The smooth, clean sweep of the craft was broken on the



A pile of Zeppelin fuel tanks. The airships must carry much fuel because of long trips and exigencies met with



Details of Zeppelin L-49: Length 650 feet, beam 78 feet, displacement 58 tons, possesses 18 gas bags up to 157,500 cubic feet displacement each, has five motors of 240 H.P. each, speed 57 knots, ascensional limit 4.5 miles, armament 18 120-lb. bombs, machine guns and equipment

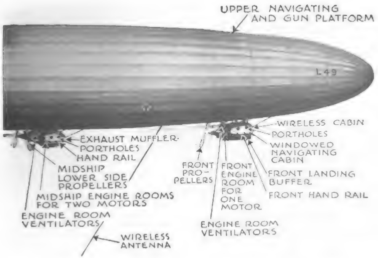
sides and at the rear car only by the mountings and shafts of two propellers—a strictly necessary evil because two of the propellers must run when the cars rest on the ground and because the others behind the cars cannot revolve.

In the old Zeppelins there was a triangular keel under the hull. The L-49 has that keel too; but it has been inverted like a glove so that now it protrudes into the interior with the apex of the triangle uppermost. It stiffens the envelope—its function from the very beginning; but two-thirds of its air friction is eliminated by this ingenious tucking away of its larger sides. Why were not the cars and engines moved into the envelope as well? There was no necessity for that. Modern science teaches that a streamlined bulk affords no more wind resistance than slender irregular appendages. The cars were given the shapes of torpedoes. Hence they offered no serious impediment to speed and dispensed with the weight of special apparatus for insulation and ventilation that would be needed for engine rooms inside the gas-inflated hull.

Small as the cars are, the space allotted for the crew is not "as restricted as in a submarine," as the French put it. There is an abundance of room in a wide passageway within the immense hull. But there is not as much comfort as may be supposed. These ample cabins serve merely as a shelter from the icy gale that beats against the outside of the ship. They are about as comfortable as the clouds of heaven are for the angels pictured in children's books. Being pitched about at sea is nothing compared with a refractory Zeppelin airship.

Wreckage of a Zeppelin. A labyrinth of aluminum frames, engines, and elaborate control mechanism

A Zeppelin is at once the flimsiest and the staunchest of artificial structures. When the old Zeppelin was



trebled in size the weight could not be disproportionately increased.

"A Gigantic Piece of Lacework," said the French

The framework of the huge hull in which the gas bags are confined has been multiplied in parts and reduced in material to a veritable cloud of riveted lattice-work made of channeled strips of the thinnest aluminum sheeting. Indeed, the frame of the L-49 has been described by the French as a "gigantic piece of lacework."

This frame serves exactly the same purpose as the pole in your wardrobe, from which you suspend coats on hangers. As a whole, the frame could resist the fiercest gale, and yet it could not support a single man's weight on one of its component parts! If ever there was a scientifically designed structure, it is this framework of the L-49. It is applied science with a vengeance! From a long row of correctly placed hooks, hang all the aluminum fuel tanks, the water ballast tanks and lastly, all the bombs—just as the clothes in your closet are suspended from the pole on their hangers. The fuel tanks are dropped through trap doors on guides like ballast. The bombs fall similarly; but they are electrically released, since the one-hundredth part of a second is vital in hitting a target and human agency is too slow.

© Kadel and Herbert

Rear view of car containing the Zeppelin engines and related mechanism. Note streamline form of the body

The Gloomy Boardwalk

Within the framework is a long passageway for the crew—a mere boardwalk, nine inches wide, composed of wooden slats separated one from the other by several inches. Along this passageway hangs a series of hammocks or cots. The crew almost "sleeps on a clothes line." Real comfort was merely a subject for pleasant dreams, for life in that passageway must have resembled that of a tight-

The padded wall which sealed off the noise of the engine room from the wireless cabin—another refinement

rope walker who dines and sleeps in pretended comfort on his lofty perch. Airships can roll and pitch like any steamer on the bounding deep, and so a hand-railing in the shape of a wire cable is provided on one side of this boardwalk. If a man stumbles he is caught by a wide netting of rope cord, "the thickness of a pencil" as the French said—a netting placed, not to save his neck, but to stiffen the cloth covering of the hull against the gale. It is doubtful if that thin netting would save him from the abyss below. I traveled in the passenger Zeppelin "Viktoria Luise" before the war. I understand now why I was warned that "passengers are not permitted outside the cabin," by an officer who saw me peeping through the door that led into the passageway. At night a man is guided along this perilous boardwalk not by electric lights (they would betray the presence of the ship to an anti-aircraft battery below), but by ghostly patches of luminous paint. Even in daytime the place must be weird and gloomy, because the ship's whole belly is painted coal black to make it invisible at night. The upper surface of the hull is painted white and gray to blend with the clouds as seen from an airplane.

Other details of the L-49, the dimensions, the power, the number of engines and propellers and their arrangement only corroborate what has been quite correctly described in previous articles on Zeppelins, published in the POPULAR SCIENCE MONTHLY. The only important progress made consists in torpedo-shaping and stream-lining all the cars.

Although life on a super-Zeppelin is not exactly luxurious, some comforts at least are provided. The protection against the biting wind is perfect. The powerful dynamos which supply the radio apparatus also furnish current for electric heating.

The material of the gas bags is cotton-lined goldbeaters' skin. To me the chief advantage of such a fabric lies in the fact that it remains gas-tight in the flabby, even crumpled condition that the gas bags so often must assume when they return to a low altitude after they have been inordinately expanded by a flight at 10,000 feet and more.

This, then, is briefly the kind of machine a Zeppelin is. Germany's well-guarded secret is in the hands of the Allies at last, and they will no doubt make good use of it. They already have a good number of air-craft of their own, but pointers are always welcome, even from the enemy. If there is anything new or advantageous about this enemy machine the Allied engineers may be depended upon to utilize it to its full value, for Germany has not a monopoly of all the brains and ingenuity.

The super-Zeppelin's wireless; the very brains of the aerial monster. Note its size

Identification Tag of Indestructible Metal for Naval Men

THE difficulty of finding a simple and adequate method of identifying soldiers or sailors who are killed or seriously injured in the course of war operations, has been solved by J. H. Taylor, of Alexandria, Va., by the invention of an identification tag which was adopted by the U. S. Navy Department on May 12, 1917. The tag, which is considered the best in use in any country in the world, consists of a plate of Monel metal, which does not melt below a temperature of 3840 degrees Fahrenheit and is not corroded by salt water. The name of the bearer and other data are written with diluted printer's ink on one side of the tag, while a rolled impression of the bearer's right index finger is placed on the opposite side. The tag is then dipped in asphaltum and the superfluous asphaltum removed with a fine brush, after which it is heated until the ink on both sides is glossy. After cooling the tag is deposited in a nitric-hydrochloric acid bath which etches the surface of the metal not covered by ink. By means of a string or chain passed through a hole in it the completed disk is carried around the neck of the wearer upon all occasions, in the same manner as a charm, for it takes up no room and is put on and forgotten.

This naval identification tag only melts in the most intense heat and is not corroded by salt water, being of Monel metal

The War Is Causing a Decrease in the Number of Lunatics

EVIDENTLY a great national struggle makes for mental steadiness. For the past two years there has been a decrease of over three thousand in the number of insane persons cared for in England and Wales. This fact is thought-provoking because before the war the yearly statistics showed a constantly increasing number of lunatics.

Rolling Roads with Gaspipe

A SIMPLE method for compacting the surface of concrete roads and removing excess water has been evolved by an engineer, B. F. Batchelder, of Ravenna, Ohio.

After striking off the surface with a template, according to Mr. Batchelder's plan, a piece of ordinary gaspipe, operated by two men, is used as a roller. After the excess water has come to the surface, another trip up and back with the roller removes all the water and leaves the surface in good condition for further finishing if necessary. A wave of mortar is carried ahead of the roller the "first time over," which fills in porous places or depressions. The second rolling removes nothing but water that is virtually clear. This method is especially useful when using crushed stone or slag.


A piece of ordinary gaspipe is successfully used as a roller to remove excess water from the road surfaces

Clopperty, Clopperty, Clopperty!—The Hobby Horses Are Galloping!

THE accompanying picture represents the "field" just before the start of a thrilling race between wooden mechanical horses invented by Axel Olfort, of Chicago, the man upon the white racer, bearing the number twelve. These remarkable toy horses are able to walk, caper, gallop and kick just like live horses and do not require any food, a fact which will be highly appreciated at the present time with its abnormally high prices, by all owners of real horses. The mechanism which enables the wooden steeds to perform their surprising movements is hidden in the bodies of the racers and acts upon the legs, which are hinged to the bodies as shown.

© Int. Film Serv

The mechanism which enables the steeds to perform is hidden, out of the way, in the bodies of the racers

Sailing Over the Tempestuous Macadam Road

SAIL-DRIVEN vehicles have been in use in China for many centuries, but their use upon the fine roads of France is rather a novelty. Some of the French aviators, in their eagerness to devise a moderately exciting method of spending their leisure time while on rest-leave behind the lines, built for themselves a sail-driven vehicle out of parts of German airplanes that had been brought down by them.

They utilized part of the framework for the body of the vehicle, put it upon pneumatic wheels taken from German machines, and to the slender mast upon the front truck they attached a sail patched together from canvas stripped from the wings of a captured German airplane. Other French aviators followed their example and soon exciting races in such peculiar vehicles became a recognized sport among the daring flyers enjoying a brief respite from their arduous and dangerous work at the front.

Land sail-boat made from captured German airplane materials and fittings

What Imitation Leather Is Made Of

LINSEED oil, certain paints, rosin, gum, and a chemical treatment — and we will have a compound as tough and as durable as leather! Such are the wonders of modern chemistry; from substances inelastic and useless of themselves, valuable commercial articles are being made.

The process for producing this imitation leather is based upon one discovered as long ago as 1864. At this time, Frederick Walton found out how a durable and sanitary floor covering could be made. This covering—the forerunner of our modern linoleum—consisted of strong canvas cloth covered with an oil-and-rosin compound heated and hardened while exposed to the air. A modification gives patent leather.

Making Two Wheels Take the Place of Three

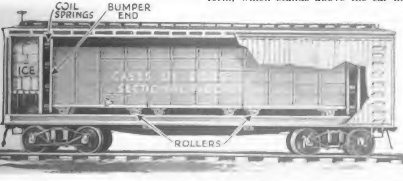
NECESSITY is the mother of invention. When the wheel of the sidecar attached to the motorcycle of Mr. John E. Hogg was crushed beyond repair by a skidding truck, while Mr. Hogg was riding with his wife near Pamona, Calif., on his way to Los Angeles, the cyclist did not abandon his trip, but completed his journey in the manner shown in the picture. First he removed the broken wheel and then he lashed a skid, improvised of a heavy board, under the chassis of the sidecar. A run of a few feet was sufficient to enable him to lift the car, with his wife sitting in it, off the ground and maintaining his balance by tilting his wheel and keeping it at the required angle. The run of twenty-five miles to Los Angeles was made without mishap, and at an average speed of thirty to thirty-five miles an hour. Much can be accomplished by a combination of necessity and ingenuity.

After a skidding truck had smashed the sidecar wheel, this cyclist tilted his outfit and rode twenty-five miles on two wheels

Shock-Absorbers for Eggs on Freight Cars Fill a Great Need

WITH eggs selling at from sixty to eighty cents a dozen and with the food shortage caused by the insufficient number of railway cars, the new design of shock-absorbing car device, shown in the accompanying illustration, should prove a boon, because it will reduce the breakage in transit and therefore reduce the cost of the eggs. A sectional platform on rollers is pushed into the ordinary refrigerator freight car so that it bears up against a series of coil springs at each end of the car next to the ice chamber.

The shocks that attend the coupling and uncoupling of cars are not transferred directly to the cases of eggs, but are taken up by the play of the platform against the coil springs at each end. The sectional floor is several inches above the main car floor. When the water from the ice boxes at the ends of the car overflows, the cases are not flooded, as the water runs off under the sectional platform, which stands above the car floor.



A sectional platform on rollers is pushed into the ordinary refrigerator freight car, so that it bears against coil springs. This absorbs the shocks and obviates much breakage during transit

Unclogging the Railroads to Get Coal

How New York's coal famine was relieved and how the Government is running the railroads

By Frank Parker Stockbridge

© Underwood and Underwood

Heavy, sea-going tugs break their way through ice jams in New York harbor, pulling immense coal barges. An example of conditions met this winter in coping with coal shortages

THE taking over by the United States Government of all the railroads of the nation, in December, 1917, and their operation as a single system, for the duration of the war, is the most sensational and interesting industrial episode of the war to date, so far as the United States is concerned. It will afford an opportunity to test many theories of railroad management and control that the roads under private operating conditions were not in a position to prove.

Almost the first action of Secretary of the Treasury William G. McAdoo, in his new official capacity as Director-General of Railroads, was to open up for freight traffic the heretofore unused short-cut between the New Jersey mainland and Manhattan Island, Long Island and the New England states, by directing that coal and other commodities should be hauled through the tunnels of the Pennsylvania Railroad's New York terminal system. These tunnels, which extend from the Jersey shore under the bed of the Hudson River, beneath Manhattan Island and under the East River to Long Island, were opened for traffic exactly seven years ago. The Pennsylvania spent nearly $100,000,000 on its terminal and tunnels, under a franchise that limited their use strictly to passenger traffic. Only the New York Central has ever had free access to New York city for its freight trains. All other freight destined for New York or for New England points can get as far as the New York Harbor terminals of the great trunk lines that converge at tidewater, but to get the cars to New York they had to be loaded on car floats and towed across the Hudson River, or the Bay, to railroad piers where they might be unloaded or whence they might be forwarded over the tracks of the Long Island or the New York, New Haven and Hartford.

Manhattan—A Cork in a Bottle

The new Hell Gate bridge, across the narrow neck of water where the East River joins Long Island Sound, owned jointly by the Pennsylvania and New Haven systems enables passenger trains to be run across to Long Island and so through the tunnels to the Pennsylvania terminal and on southward. Freight trains were sent over the new Connecting Railway to piers in Brooklyn, whence the water haul to the New Jersey piers was much shorter and safer than the old route. But the prohibition of freight

traffic through the tunnels still left Manhattan Island like a cork in a bottle, preventing the free flow of traffic by the shortest and easiest route.

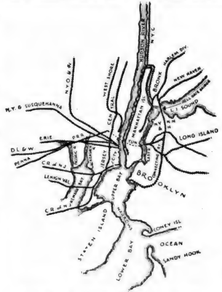
Government control of railroads was the corkscrew used by Director-General McAdoo to pull the cork. It so happened that his taking over of the roads almost coincided with the worst coal shortage the East had ever known and the lowest temperatures in the history of the Weather Bureau. Freight could be moved in the Hudson and East Rivers only with the assistance of ice-breaking tugs. Hundreds of thousands of tons of coal were in cars at the various Jersey terminals; New York and New England were freezing. The cars could be sent through the tunnel. That is what the Government ordered done. From the Long Island yards coal was hauled across the Queensborough Bridge into Manhattan with less difficulty than it could have been handled from the piers formerly used, while trainload after trainload was sent on over the Hell Gate bridge to New England.

Cutting Down the Passenger Trains

Freight traffic counts for everything, passenger traffic for nothing, so long as it is necessary to rush coal and raw materials to the factories where munitions are being made, and shells, guns, explosives, aeroplanes, wheat and food supplies for our army in France and for our allies to seaboard shipping points and soldiers to and from training camps. The freight must be moved by the most direct and fastest routes. Under competitive conditions, the railroads could not meet the demands made upon them. One had not enough locomotives; another too few cars; a third could haul certain classes of freight only by roundabout routes; other roads were competing for the classes of freight that they could haul to best advantage. So the first result of Government control was to cut down the number of passenger trains. On the Pennsylvania system 104 weekday trains and 51 Sunday trains were cut off by a single order; the New Haven annuled 82 passenger trains; the Lehigh Valley's reductions in passenger service between New York and Buffalo save 75,000 train miles a month. Through trains that formerly carried sleepers throughout their run now hook on the sleepers at bedtime. Instead of

Clogged! A typical scene in a New York freight terminal

taking a Pullman at New York when you go to Chicago by the Pennsylvania, for instance, you ride in a day coach to Pittsburgh and enter your sleeper there. Pullman chair cars on daylight trains are limited to one car per train. An exception is the famous Congressional Limited, between New York and Washington, which formerly carried only Pullmans and made the run in five hours, but which now carries four Pullmans and six day coaches and takes six hours for the trip. Observation and club cars have been cut off; diners are hauled only on important trains, and then only for the shortest possible distance.



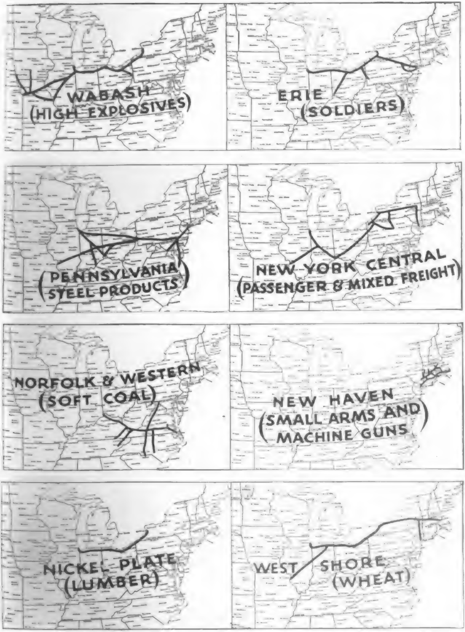
Showing the railroad lines that converge at New York. Situation is complicated by the Hudson River and, at present, by ice

"Put the punch in car movements," is the slogan adopted by the railroads—and freight cars are what is meant. Demurrage rates, or charges made against consignees for failure to unload cars promptly, have been doubled by Mr. McAdoo's order. The roads no longer have to return freight cars to the lines that own them, but treat "foreign" cars as their own and load them for any points to which they have freight to ship. The unlimited pooling of freight cars is already relieving the car shortage situation greatly.

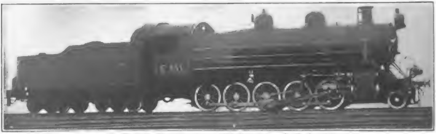
The next big step, for which plans had been drawn early in January by the advisers of the Director-General, was the further elimination of competition between the roads by arranging to have certain kinds of freight carried by one road, other kinds by other roads, and all the facilities of each line centered on the most


Cincinnati coal barges caught in mid-river by an ice jam. Citizens crossed treacherous ice on boards to get at the coal. All the country has gone to such lengths to escape freezing

What Railroads Are Now to Carry



Under the Government plan of operating the railroads of the country as a single system, each line will be required to do the particular kind of hauling for which it is best equipped



A number of these big Russian locomotives of 5-foot gage, built in this country, are now being adapted to our 4 ft. 8½ inch gage and used on our own roads. Two hundred will be used

expeditious movement of its particular classes of commodities. The accompanying map-diagram, showing how the nation's railroads converge at the Atlantic seaboard, indicates how freight and passenger traffic may be divided among the various lines. The Lehigh Valley road, for example, already brings to New York more flour than any other railroad. Its terminals at Buffalo and Jersey City are equipped for the handling of flour on a huge scale. The logical extension of this existing condition will be to divert all the flour traffic from other roads to the Lehigh, and if its terminals are insufficient it can use the Lackawanna terminals, which also have equipment for the repacking and handling at tidewater of flour for export; for under the Government's rulings, every road's terminal facilities are open to the use of every other road that needs them, just as the rolling stock and motive power are interchangeable. Five important railroad systems tap the hard coal region of Pennsylvania. Some haul coal from the eastern part of the field to the West, others haul it from the western part of the field to the East. This crossing of coal shipments has been stopped. The Norfolk & Western, for instance, could be diverted entirely to coal traffic, except for a small amount of short-haul local passenger traffic, while all other freight originating on its lines could be well handled by other roads. Plans tentatively proposed would make the huge Pennsylvania system exclusively a freight road, mainly for steel and its products, except for local passenger traffic between points not well served by other lines.

Car-loads are already nearly twenty per cent heavier than they were, due to the system of intensive loading urged upon the roads by the Railway War Board before the Government took charge; trains are ten per cent longer. Still there is a great shortage of locomotives. A list of questions sent to the heads of all the railroads late in 1917, asking what their greatest needs were, brought forth the almost unanimous response: "More locomotives." Many of the roads had not been earning enough to buy the locomotives they needed, especially at the 50 per cent increased cost due to war conditions; all the locomotive builders in the country, too, had been busy on huge foreign orders, notably for Russia.

Within a day after the Government took over the roads 100 brand-new locomotives, bearing the letters "U. S. A." on the sides of their tenders were placed in service on several Eastern lines.

These locomotives were not built for American service, however, but are part of an order of 980 locomotives bought by the War Department for use on the American roads in France which are being constructed to transport men and supplies from French ports and bases to the American sector of the fighting line. These Government locomotives are soon to be supplemented by 200 locomotives built for the Russian government, part of an order of 2,075 all of which will be completed in American shops by July.

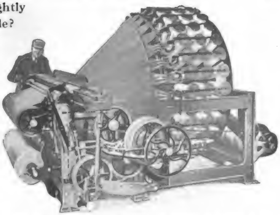
Why You Receive Popular Science Monthly Late

So great is the congestion of railroad traffic, that the delivery of Popular Science Monthly and other magazines is very irregular, and generally much delayed. During the next two months, owing to the "Fuel" holidays, still more delay must be expected. We are sorry. Please be patient.

Why Not Take Your Nightly Rest in Your Library Table?

NOT so many years ago, when apartment dwellers first began to feel the pinch of space limitation in their diminutive quarters, combination furniture was all the rage. Anyone visiting a flat dweller could never feel quite sure whether the book case he admired in the parlor was really what it seemed to be or a bed in disguise. Beds are such cumbersome things. Put a bed in a room and the room becomes a bedroom, the privacy of which excludes outsiders as a matter of course. From the very beginning, inventors have therefore concentrated their efforts upon the problem, how to disguise the bed, as it was clearly impossible to eliminate it altogether. Some of the attempts were quite remarkable, but few were practicable. Rather original is the combination of a library table and bed shown in the picture, an invention by E. T. Bronsdon, Chicago. By a few simple operations, the solid-looking library table in the parlor or studio can be changed into a comfortable and sanitary double bed fitted with sagless springs and felt mattress. This seems to be one of the most practical suggestions, so far, for saving space.

A few simple operations convert the table into a comfortbale bed



The loom that weaves a diagonally reinforced fabric is a complicated piece of machinery, yet remarkably compact

A Fabric With Diagonal Reinforcing Threads, Useful for Automobile Tires

THE urgent need of a cotton material which will meet the requirements of a tire foundation (flexibility, strength and resistance to strains in the direction of the threads and diagonally) stimulated Mr. William G. Trautvetter of Paterson, N. J., to invent a loom by which it is possible to weave a cotton fabric with diagonal reinforcing threads. The picture shows the perfected loom, which is remarkably compact.

The diagonal threads are carried in spools mounted in a large reel. As the reel revolves, the threads of the upper half are moved across the fabric in one direction, while those of the lower half are carried in the opposite direction, diagonally across the fabric. The filling or weft threads always pass under the warp threads, and over the bias threads. Since the diagonal threads are interlaced with the warp threads, while the weft threads are intermeshed with the warp and with the diagonal threads, a fabric is produced which is remarkably strong in every direction.

Indirect Fire from Springfields

A periscope attachment and a twenty-five-shot magazine are two of the important improvements

By Edward C. Crossman

The rifle is growing bulkier as its uses increase

PERISCOPE attachments for the rifle are an old story from the days of 1915 when Tommy Atkins put a rude contrivance of sticks and pocket mirrors on his Lee-Enfield and went to potting at the Germans across the way. Periscope, in case you've forgotten, means in this connection merely an arrangement of two mirrors, one up in the line of sight on the barrel of the rifle, the other down at the level of the eye, well below the trench parapet, enabling the soldier to aim and fire the rifle while remaining far below the line of the barrel.

The new combination developed by our Army Ordnance Bureau is put on without permanent alteration of the rifle. Our Ordnance Officers look with jaundiced eye on anything for the rifle that entails machining or alteration of the gun.

The periscope is so mounted that the shooter can stand below the lip of the trench parapet, protected from the overhead fire of shrapnel, which is not true of all periscopes. Also it is so hung that the recoil of the rifle swings the lens away from the eye, instead of pushing the shooting optic all over the face as is the case with some periscopes. An extension enables the trigger to be pulled from the level of the shooter.

The second point is that the rifle is fitted with a twenty-five-shot magazine instead of the customary five shots of the service rifle. The change is made by merely sliding the present floor-plate out and sliding the top of the frame of the new magazine into its place. This enables a great number of shots to be fired without taking the rifle down to reload. The Germans are said to have fitted up a number of their Mausers with these large capacity magazines some time ago. There is without doubt, much need for greater capacity than the present five-shot, clip-loading magazine.

The third novel point about the converted rifle is the use of translucent rear sight, colored red or green. The front sight is colored the one or the other of the contrasting colors—green when the rear sight is red, and vice-versa. The inventor, trying out his rifle in actual trench fighting, found that with the ordinary metallic sights, showing, of course, merely black in silhouette against a mark and hard to distinguish, the rifleman could not always define the objective, as the greenish uniform of the German soldiers did not throw them up in sharp relief. Often mist confused the issue still more. So he evolved the contrasting front sight, a vivid green or a violent red.

The advantage of the translucent slide is that it does not cover up the mark, and enables the rifleman to pick it up much more quickly than is possible when using the steel slide with the small aperture of the service rifle. This should prove very valuable in trench fighting.

The trigger is pulled from the level of the shooter by means of an extension mechanism

Germany Plows With Electricity

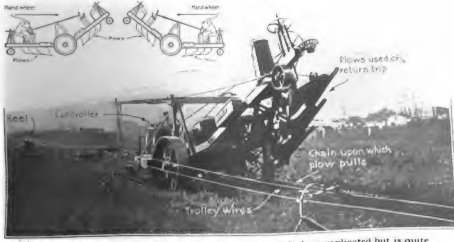
Men are becoming so scarce that all mechanical helps possible must be used

TO such straits is Germany reduced for men that she must make maximum use of the few who can be kept at home to till the soil. Her difficulty may be conceived when it is considered that even in time of peace women had to plow, sow, and reap. Now she has been compelled to adapt electricity to farm work. In the accompanying illustration we show an electric plow presenting many uncommon features. Old Hans, sitting at the far end, one hand on a steering wheel and the other on a controller, regulates the speed of the driving motor. This motor turns a drum, over and around which passes a chain stretching clear across the field and anchored at the other end. The chain simply goes around the drum and then passes out at the back, remaining in place until the machine again passes the point, on the same principle as the familiar capstan on a steamer.

Current is delivered by means of two trolley wires supported at short distances along the ground. Reels at each end of both the trolley wires and the chain keep all three reasonably taut. The reels are mounted on little carts, so that they can be moved sidewise as operations proceed and the amount of plowed ground increases.

The machine does not need to be turned around at the end of the furrow. Hans simply draws the plows he has been using up against the frame and adjusts certain levers, whereupon the end he has been using rises and the other end descends. He then climbs to that end, releases the trip of the other set of plows which it carries, reverses his motor, and is ready to go back again, the drum this time pulling the other way on the chain lying along the ground. Use of this chain apparently gives better traction than would ordinary driving wheels.

This plow contains many ideas of interest to those who follow tractor development. The caterpillar tread is one way of getting traction on soft ground. This chain plan, however, would seem as good, or even better, in special kinds of plowing, owing to its smoother action and the very positive drive.



Hans has a great time plowing with his electric plow. It looks complicated but is quite docile. How he turns around at the end of a furrow is indicated by the small sketch

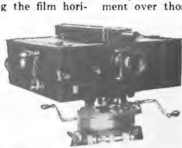
Giving the Motion Pictures a Larger Frame

Each picture will be one-third higher and one-half wider than the old standard size

The white line divides the old style film from the new, while the dotted line indicates its size in proportion. One "sees around corners" with this device

A NEW form of motion picture which moves horizontally instead of vertically and uses a picture twice as large as the present standard has made its appearance.

The new picture, made on the standard motion picture film, is exactly twice as wide as the present picture is high, and its height is equal to the width of the present picture. This will give a picture on the screen of a different proportion from that now shown—one-third higher and one-half wider. The present picture is in the proportion of three to four and the new picture will be as four is to six. This is accomplished by running the film horizontally and using two "frames" for each picture. Only a limited number of large theaters will show the pictures. The screens of these theaters will be increased in size to twice the present area. The figures of the actors will be as large and even larger than those now projected so that an immense breadth of action is obtained as compared with the present very limited "stage."



The camera which takes the larger pictures is the "other way around"

The process is controlled by W. W. Hodkinson. He counts on a great addition to the directing and production of pictures through the use of the larger "stage" and believes that after the public has seen the larger picture, it will look upon the old film as it would on the necessity of looking through a knothole at the stage of a legitimate theater and show a marked preference for the new.

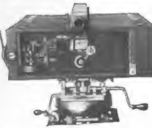
Mechanically the new process is extremely interesting. Standard lenses are used in the photographing. There is consequently no loss of light. The camera is so gaged that with the standard lenses a tremendous depth of focus is attained.

The projection machines used in the new process are a tremendous improvement over those at present in use. A flickerless picture has been attained through simplification of parts on the projector and introduction of new shutter principles.

The amount of film used for each picture will not be doubled. The larger screen, in which more can be shown, will obviate the necessity of the "cut backs" which are now used to show simultaneous action.

The new process of picture making is the first great improvement in the method of making motion pictures which has been introduced in the business, and it bids fair, in time, to revolutionize it.

For nearly twenty years the industry has used the same film and the same size picture which were introduced in the first years of the century as the standard product. In these years magnificent motion-picture theaters have been built, fortunes have been spent in the salaries of stars, and the cost of settings and directors has soared into the hundreds of thousands per picture. The presentation method, however, has stayed in the old channel, and the old film size, which was designed for cheap "nickelodeon" theaters has continued.



Camera showing the lens removed

The new process is being introduced, its sponsors state, in order to get up a standard of quality by which the public can judge the pictures it wishes to see. It is stated that the new process, which practically controls this size and shape of picture, will be used only for the highest class productions. Producing franchises will be given to the manufacturers of all high-class pictures and steps taken to gain their interest. Once the new style of pictures become known to the public, they will certainly become popular.

Turning an Eyesore Into a Dignified and Imposing Structure

AGAIN it has been proved that even a strictly utilitarian structure need not be ugly. In Cincinnati, some unsightly steel water standpipes have been placed in an architecturally pleasing concrete shell. Now the residents of the neighborhood see a concrete industrial monument instead of hideous, painted metal cylinders. The utility of the tanks has not been injured in the least, so the strictly practical business man need not object.

The reservoirs were filled with water before the shell was built. Had they been left empty, slight changes of shape might have occurred when the water flowed in, with the result that the concrete would have cracked. The forms to hold the concrete around the base of the tanks were braced to the foundations, while the higher forms were raised on derricks which were manipulated from floats on the water surface within the tanks. The result is a landmark of pleasing appearance.

Before: The unsightly tanks as they looked at the beginning of their metamorphosis
After: The dignified and imposing castellated structure at the finish of the operations

Making a Million Out of a Sunken Ship

The problem of the *Gut Heil*, a German tanker that lay on her side at the bottom of the Mississippi

By Robert G. Skerrett

FIVE years ago, a double collision sent the German tanker *Gut Heil* to the bottom of the Mississippi a half mile below Baton Rouge, as she was outward bound with 3800 tons of oil. As a ship, she was worth about $300,000; and $125,000 was spent afterwards in an unsuccessful attempt to refloat her. Today, thanks to extremely clever salvage engineering, the craft is afloat and valued at not less than $1,000,000, mainly because of the scarcity of ocean-going bottoms.

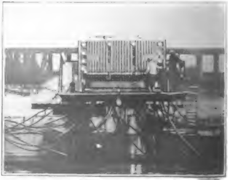
The *Gut Heil* rejuvenated; ready to float out of the muddy Mississippi and into the Gulf for refitting

As the vessel was not held in hand, so to speak, when wreckers first tried to raise her, she turned over while partly afloat, filled with water, and sank on her side. In that position the task of raising her appeared hopeless, and so she was abandoned by her owners. A few months ago interest was revived in her, and a well-known New York salvage company was asked to make another effort to recover her. After preliminary study the work was undertaken as it was believed that the difficulties could be circumvented and the vessel successfully refloated.

As she lay submerged, the *Gut Heil* represented a dead weight of 6,000 tons, 4,000 tons of the burden being in the form of mud that had displaced her cargo of oil. How was it possible to get rid of that load of accumulated silt and then make the ship right herself? Past experience made it clear that she would have to be controlled perfectly at every moment. If she acquired too much momentum at the start the impulse might carry her far enough over on the other side to allow the water to rush into her and to cause her to founder again.

To get the mud out of her, the salvors devised a siphon operated by compressed air. It did its work well. Her fourteen oil tanks were fairly well cleaned out, so that it was possible for the divers to examine her condition. They reported that her main longitudinal bulkhead, reaching nearly her whole length, was not tight where it met the metal deck above. Since this had to be tight it became necessary to seal the long divisional wall of steel. This was done under water. Divers made a union between the bulkhead and the deck with reinforced concrete. They also closed the two wounds in the tanker's side with the same material.

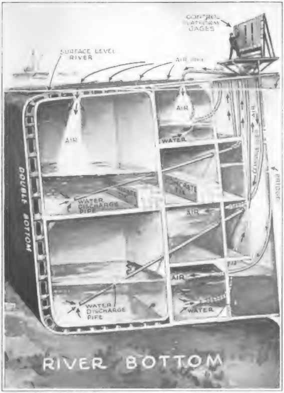
The vessel was blown out by com-



Here the master wrecker watched gages and controlled the raising of the *Gut Heil*

pressed air. To each compartment was led a flexible connection of hosepipe, and through these hoses the exact amount of air desired was fed. When the tanker became too buoyant and threatened to keel over on the other side, the air pressure was released so that the water could reenter. In this way the ship was nicely controlled.

All of the pipes centered at a pivoted platform, arranged so as to maintain a horizontal position during the righting of the vessel. On the same platform was set a standing frame holding a double system of gages with the usual dials. One of these indicated the amount of compressed air available in the several reserve flasks, while the other one, consisting of tubular mercury indicators, showed the air or buoyancy in the different compartments of the craft. The wrecking master had a visible guide of the steamer's internal state and a complete index of the forces he was calling to his service both to move the *Gut Heil* vertically and to check or regulate her motion laterally. It was as easy as reading the time on a clock. Literally, by a hand's turn, he could juggle the air and water within the tanker so that the rising and swinging of her dead weight of many thousands of tons could be managed to a nicety.



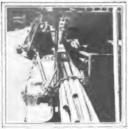
How the raising was done. Air supplanted water in the various chambers of the ship, gradually floating her

Two months of careful preparation were required to get everything ready. The ship was then soon raised and righted. Indeed, turning her vertically and bringing her to the surface was but a matter of minutes. Her present owners, after allowing for all expenses, have netted a gain of more than $800,000, and the ship is in such excellent condition, in spite of her long submergence, that her engines will be able to drive her after they have been cleaned.

It is such exploits as the above that are making history in the annals of salvage.


She lay on her side in mud, making salvage difficult. The water was blown out of her by compressed air

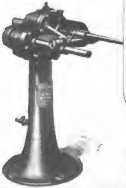
Do It with Tools and Machinery and Speed Up Your Job



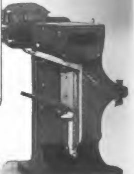
The usefulness of this motor-truck is increased by side brackets, as shown

This attachment is for drilling in difficult places on castings and other work

A gas torch in which an electric fan forces out the gases, making a flame up to twenty-four inches long



Machine for forcing out obstructions in hollow steel tools used in rock drills



Motor-driven machine for cleaning the space bands on linotype machines

A new type of portable conveyor which is driven by an electric motor. The lower end has a scoop for pushing into the material

Above in center: A tape line which registers the length measured on a dial which is on top of case

A self-contained rock drill. It is worked by a small gasoline engine attached to the tripod used for holding the drilling machinery

Some Little Conveniences For Busy Office Workers

An arm for holding the telephone securely in any position. The arm incloses and protects the cord

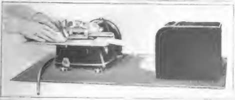
Below is shown a typewriter equipped with mirrors to reflect the writing near the keyboard

The typist who desires a stand of just the right height on which to place her machine should have one which can be adjusted like the top of a piano-stool

This moistener for sealing and stamping envelopes consists of a holder in which a damp sponge is fastened

The little hand-machine shown below makes it unnecessary to use paper clips. It cuts, folds and clasps a portion of the paper to hold the sheets together like a clip

Below: A stamp affixer. The stamps are applied one at a time by drawing the device across the envelope



A small electric letter opener. Only a small shred is cut from the edge of the envelope

Marionettes Extraordinary

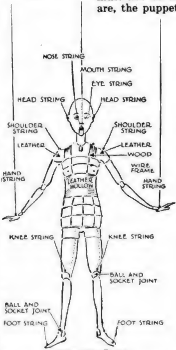
An ancient art brought up-to-date

By A. M. Jungmann

A Smoke by Proxy

This picture divulges to us the secret. The young lady, who stands in the wings, is responsible for the merchant's smoke. She takes a puff from a cigarette and blows the smoke into a rubber tube which leads into the puppet's mouth, and gives a very realistic effect

THERE is no telling what may develop from the hobby of a collector. The most life-like puppets that ever graced a miniature stage came into being just because an artist had the hobby of collecting toys. Some years ago Tony Sarg, a New York illustrator, began the collection of old-fashioned toys. He picked them up in all parts of the world. One day he came across a puppet which had been an actor in a puppet show. This little wooden figure, poorly designed and lacking in joints, gave Mr. Sarg an idea. Why not puppets capable of giving really good imitations of human beings?



How It's Done

If you are curious to see what makes the puppet act in such a life-like manner, examine this drawing. You will be able to see how its joints are arranged and how the strings the puppeteer so cleverly pulls, are attached to the joints

This question was more easily asked than answered. But after several years' hard work on the part of Mr. Sarg, the puppets are here to speak and act for themselves. To design natural-appearing puppets requires, among other things, a knowledge of anatomy, mechanics, art, the principles of the drama, and the craft of the costumier.

One of the first points which had to be settled was the question of size. The average puppets are too small to simulate living human beings on the stage. On the other hand, it is possible to have the puppets too large. Mr. Sarg finally decided that puppets about three feet in height were the most satisfactory. They must not be too heavy, because if they are, the puppeteer cannot operate them. Finally, they must be constructed with joints which will enable them to move just as a human being moves.

These puppets move, not only their hands, feet and heads, but their eyes and mouths as well. Imagine a puppet making goo-goo eyes at his lady love!

The design of the puppet is very ingenious. The head is fastened to the shoulders in such a manner that it can move forward, backward, and sidewise. The arms have ball and socket joints in the shoulders, elbows and wrists. One of the puppets, which takes the part of a singer, is built so that its chest rises and falls exactly as does the chest of a person who is singing. Movement at the waist is provided by means of flexible material, and the legs are joined to the trunk by

pieces of leather, which are so arranged that the puppet is able to imitate the natural movement of the hip. The knees and ankles both have ball-and-socket joints, but in the case of the ankles the movement is restricted so that it is impossible for the puppet to lose control of its feet.

The puppets are controlled by a number of fine strings which are attached to a little wooden device which looks a good deal like an airplane and which is called the controller. The number of strings necessary to control the puppet runs from fourteen to twenty. The string has to be very strong, yet fine because it would never do for the audience to see it. After many experiments, Mr. Sarg found that Japanese trout line is the most satisfactory material for the purpose. The line is very fine, not as coarse as the thread ordinarily used for sewing on shoe buttons, yet it will support a weight of forty pounds. Although all colors and combinations of colors have been tried, black is the color which is least visible to the audience. Experiments were even made in camouflaging the string after the manner of camouflaging submarine periscopes. But black has been found to have the lowest visibility.

Two bridges are built over the stage on which the puppets appear. The puppeteers control the puppets from these bridges. Each puppet has an actor who reads the lines. As the puppet moves across the stage, the actor follows it on the bridge. In this way the audience hears the voice always coming from the part of the stage on which the puppet is located.

It is very difficult to train people to be good puppeteers. The new puppets are controlled by girls. Learning to control a puppet is a good deal like learning to play

The Stage Director and the Always Pleasant Actors

A scene in one of the plays. Look at the stage director who is speaking to the puppeteers on the bridge above and you will get an idea of the size of the puppets. When seen alone they appear life-size, so cleverly are the furniture and the stage settings designed. The fearsome skeleton is arranged to fall to pieces on request

a musical instrument. Some girls can learn to operate the puppets in about two weeks, while in other cases it takes months to train them. The most difficult thing for a puppeteer to do is to make a puppet walk. The puppeteers are taught to walk the puppets with their eyes shut because it is so very important to have the puppet walk in a natural manner, that the puppeteer must accomplish this automatically. The feat next in difficulty for the puppeteer to learn is to make the puppets look at each other in a natural manner. The puppets can pick up objects, throw them down, and mount and dismount animals. In fact, they can do practically everything a person can do. It is far easier to make them dance than it is to make them stand still. When they are standing, they have a tendency to sway. The skillful puppeteer can prevent this, but it takes a great deal of skill to hold a puppet motionless on the stage.

The puppets have their own miniature stage with a miniature lighting system which is similar to that used in Broadway productions, even to the colored footlights. In order to prevent those of the audience who are sitting near the stage from seeing the strings, a frame is arranged in front of the stage, on which the trout line is stretched vertically. This screen of trout line effectually conceals the movements of the strings which are attached to the puppets. In writing a play for puppets, the lines have to be specially written to accommodate their movements. There can be no short speeches as there are in plays written for living actors.

Pulling the Strings

The rich merchant seated on his cushions enjoying a smoke. The young ladies above him are pulling the strings which make him and his fellow puppets act. The puppeteers are invisible to the audience

Among the company of puppets are dogs, rabbits, donkeys, and horses. In one of the plays a skeleton comes on the stage. It always amazes the audience by its acting of the supernatural. It is so constructed that it falls to pieces and pulls itself together again. This trick is possible for the simple reason that the skeleton has hollow bones through which strings are run.

This system of managing marionettes is, of course, a refined version of the old time method. Puppet shows in themselves are as old, almost, as acting by living persons. It will be remembered that Cervantes has an incident in his immortal satire, Don Quixote, in which that celebrated and chivalrous nobleman achieves lasting fame by routing the gang of scurrilous knaves who were abducting the fair damsel in a puppet show belonging to a strolling player, to the owner's great disgust.

Motor Trucks Pull Subway Cars

Construction work is facilitated by trusty gasoline tractors that rush materials where needed

MOTOR trucks are today running in New York's subways. To be sure, they are not carrying passengers, because the portions of the tubes in which they are utilized are not yet completed. Still, they are performing the very good service of rapidly transporting earth and rock, or bricks and steel, from one point in the system to another. The great amount of material which must be handled inside of the tubes may be realized when it is considered that the streets over the subway have to be kept open while the construction is going on. The torn-up portions of the roadway have to be put down just as soon as the concrete roof is finished, leaving the placing of the rails, switches, and signal equipment for a later time. In order not to impede street traffic, the shafts down which the material is dropped are placed as far apart as possible. This makes long hauls necessary inside the tube itself.

As the current will not be turned on in the third rail until the regular passenger trains are put into operation, the problem of getting long, sixty-foot rails and heavy switches to the proper points on hand cars seemed too formidable for solution. Finally the superintendent decided to use a regular motor truck fitted with flanged wheels. There was none of the smoke and steam that accompany the use of locomotives. Moreover the regular flat car was rendered unnecessary, because the motor truck was converted into a tractor with a fifth-wheel at the rear instead of the usual body.

Ten to fifteen tons of sixty-foot rails are in this way pulled by a one-ton truck. The weight of the front ends of the rails rests on the truck fifth-wheel and the weight of the rear ends on an ordinary hand car, as shown in the illustration. The fifth-wheel support enables the truck to turn curves and run over cross-over tracks just like any locomotive. The truck is furnished with a searchlight mounted high on a rod extending up from the dash. This and a regular truck horn give men working along the track a warning of the approach of the unusual vehicle.

This adaptation of the familiar motor truck has much facilitated the work.

A fifth-wheel is mounted on the rear of the motor truck. Rails and beams ride on it and on the small hand car in the background. There is no smoke, as with an ordinary locomotive

Did He Join the Army or Navy? This Service Flag Tells

ONE of our Jackies, Maurice Clement, the Quartermaster on the U. S. S. *Texas*, thinks that the conventional service flag which is now flying from innumerable windows all over the country, has one defect. It does not tell what branch of the service each man has entered.

Now Quartermaster Clement is extremely proud of being in the navy, so, when he came to make a service flag for his own home, he framed the central white space with a piece of white-line tied in attractive knots. At the top and bottom of the panel he made a double Carrick bend; at each side, at equal intervals, a figure eight knot, and then a square knot, thus making a balanced design.


White-line tied in sailor-knots frames central panel of this naval service flag

This flag is not only very attractive, but it leaves absolutely no doubt as to what branch of the service it symbolizes.

The U.S.S. *New York* as She Appears in Pipes and Pipe Fittings

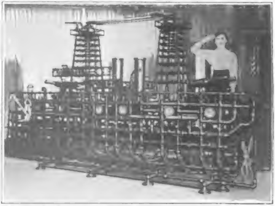
HERE'S a curious new battleship, a model of the U. S. S. *New York*, made entirely of pipes and pipe fittings manufactured by a prominent firm.

The boat is formed of forty-seven different kinds of pipe fittings, four types of valves, a brass whistle, oil cups and valve parts. It is electrically wired, so that its propeller revolves, its cannons fire, and its wireless apparatus emits sparks.

The man who conceived and built the vessel is Julius Gerion, a Belgian mechanic, employed in the company's shops at Bridgeport, Conn. He drew no plans of any sort, nor had he ever inspected a battleship. He simply copied photographs published in the magazines and papers. For ten weeks he worked at his toy, evolving it part by part. Six thousand, six hundred and sixty-nine separate pieces were used.

The Merits of the Wooden Barrel are Obvious

A BARREL can be rolled. This is its greatest merit. Every other shape of container which weighs over a hundred pounds when filled, must be lifted bodily and carried on a hand truck or by hoisting machinery. One man can unload a carload of sugar—two hundred barrels of it—in less than an hour. Don't you wish it were at your door? No other container can be handled at this rate, even by two men working at top speed.


© Underwood and Underwood

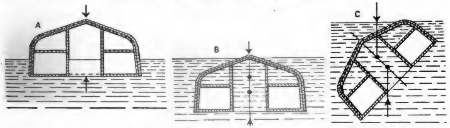
Model of the U. S. S. *New York* made entirely of pipes and their fittings. It is the work of a Belgian mechanic

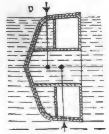
Launching Concrete Boats Bottom Up

Norwegians are shipbuilders of old. Now they've devised a new way of building and launching vessels

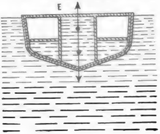
LAUNCHING a two-hundred-ton concrete vessel bottom up may sound fantastic, but it has recently been done with success by a shipbuilding company in Norway. The vessel was a reinforced concrete lighter (concrete strengthened by a skeleton of steel strips), and consisted of an inner hull of wood which served as a mould for the whole structure. When completed, there rested upon the launching ways the inner wooden mould, divided into watertight compartments, and the outer concrete hull, both bottom up. An inner compartment was left open at the bottom, so that water entered as the vessel left the ways, the air escaping through pipes in the hull. When this compartment was completely flooded, the water then reached the level of the two upper side compartments, causing the boat to lose its buoyancy and submerge to a position of unstable equilibrium. In this position, a slight list to one side caused the boat to heel over completely and float to a normal position.

Though launched bottom side up, and with a wooden form inside, the big boat slid smoothly into the water





Position A shows the boat just entering the water, the wooden form inside, and all of its watertight compartments full of air. In position B—water has entered the center compartment and also those along the bottom, the air escaping through vents. At C—the two lowest compartments, closed to the water, are buoying up on the boat and causing it to turn over. Drawings D and E show further stages. The water is afterward pumped out



Varnish and Varnishing

Strange gums and oils and how they are made into protective coatings

By H. M. Beattie

VARNISHES are of two kinds. Spirit varnishes are made by dissolving a gum, such as shellac, in alcohol, but oil varnishes, in which class are most of the varnishes we know commercially, are made by cooking resinous gums in oil, and adding thinners, such as turpentine, or a petroleum product.

The character of the varnish depends on the qualities and properties of the raw materials used. Much gum and little oil produce the hard, high gloss, rubbing-varnishes used on pianos and furniture. Varnishes which must be more elastic and tougher, but which are not exposed to the weather, contain a less proportion of gum to oil, while the exterior varnishes of all kinds contain the greatest quantity of oil and are known as "long-oil" varnishes. Varnish which is used on a railway coach must have elastic qualities, and must be able to withstand the elements better than the varnish used on a chair, or on the interior trim of a house. The varnish that is used on tables and interior trim must be able to withstand more blows and rough treatment than the carriage varnish. The varnish maker has spent many years in developing a particular varnish for each particular purpose, and while he makes a universal varnish adaptable to almost any need, experience has shown that for the best work, a particular varnish manufactured for a particular purpose always gives more lasting satisfaction.

The long-leaf pine which grows in our Southern States produces both turpentine and resin

Varnish Making Begins in New Zealand

The gums used in varnish come mostly from New Zealand and from Africa. The gum from New Zealand is called kauri gum and is the best known. It is a semi-fossil resin that has been buried in the ground, many hundreds of years. It is sought for in primitive ways. Armed with a long iron rod, the native prospector explores the ground sometimes to a depth of six feet. He can tell by touch when he strikes gum. He then digs up the piece, which may weigh a few ounces or many pounds. He sorts this gum and sells it to the foreign middleman who in turn deals with the varnish maker. The kauri gum is a harder, tougher gum than the African gum and commands a higher price.

The oil most used in the manufacture of varnish is linseed oil. Linseed oil is obtained from flaxseed. Flaxseed has

Varnish Making Begins in New Zealand

This Chinaman's grandpa did it this way, and grandpa's grandpa and all the rest. It's a family custom, don't you know? "Tung" nuts are being ground down in the trough. They give a valuable oil, useful in varnish and finishes

Pressing the "tung" nuts. The apparatus is crude and ages old. The meat of "tung" nuts is much like that of Brazil nuts. The oil obtained gives a more waterproof finish than does linseed oil. Varnish makers buy it in large quantities

This little jungle maid has been out prospecting for kauri gum. She thrusts her long, iron rod in the ground and tells by touch when it has located a lump

Kauri gum passing from the native New Zealander to the exporter. The material is a semi fossil resin found underground where it has lain for hundreds of years. A lump may weigh a few ounces or several pounds

been grown in the northwestern States, in Canada and in India for many years. A new and important source of supply is Argentina, in South America. The flaxseed is crushed and then heated to a temperature of about 160 degrees. It is pressed in large hydraulic-presses and yields from 26% to 34% of linseed oil. This oil is settled or filtered, and then treated chemically to remove certain mucilaginous matter, called "foots," before it is ready for the varnish maker.

China Contributes a Wonderful Oil

China wood-oil is another large factor in varnish making. It is the product of the "Tung nut," a nut growing in China. The nut has a soft shell and a meat similar in appearance to the Brazil nut. The shells are removed, then the nuts are crushed, heated and pressed in the most primitive way to produce the oil which is shipped to this country for varnish making. The oil has peculiar waterproof qualities not common to linseed oil.

Varnish kettles. A coke fire heats them. The gum is melted, then oil is added

Varnish makers experiment many years to get better mixtures. This is a brush test

Turpentine is the product of the long-leaf pine tree, grown in the Southern States of this country. The sap of this tree is collected and distilled. The distillation produces turpentine and resin. Resin is also used in the manufacture of the cheaper varnishes and after it has undergone certain treatment it becomes fit for use in varnishes of better quality.

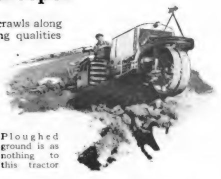
All of the raw materials are brought together in the varnish factory and carefully tested and graded for purity, color and other characteristics.

How the Varnish Is Made

The varnish itself is made by melting a quantity of gum in a covered copper or aluminum kettle, over a fire. Coke is the fuel usually employed. The varnish maker knows when the gum is sufficiently melted, by the way it runs off the end of his stirring rod. The kettle is removed from the fire, and the oil, which may or may not have been previously heated, is added to the melted gum. The cover is removed and the kettle returned to the fire. The mixture is then cooked at a determined temperature until it has a certain viscosity or "body." The kettle is cooled down to a temperature at which it is safe to add the thinners. The next step is the aging of the varnish. Certain varnishes attain their perfect condition only after long months of standing in tanks, where a slow blending-process goes on. This aging gives to the varnish properties that make it last. The varnish has to pass rigid tests for "body" or viscosity, for color, and for drying quality also brushing and flowing tests before it is ready for the market.

The Ball-Bearing Creeper

It coasts down plowed ground and crawls along hillsides because of its easy-running qualities

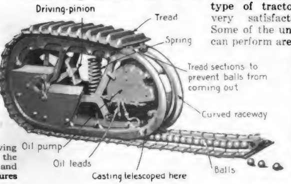


Ploughed ground is as nothing to this tractor

ANOTHER step forward has been taken in the reduction of friction and therefore of loss of power, in farm tractors, by means of the introduction of ball-bearing creeper or track-laying units.

The use of ball-bearings in creeper units has two great advantages. The first is the saving in power effected by the reduction in friction, as a result of which saving, more of the vehicle-power can be employed for doing useful work in pulling plows or other equipment, instead of being consumed in merely moving the tractor itself. That follows from a test which was made by the University of California and in which a ball-bearing tractor actually coasted down plowed ground with a three per cent grade.

The second advantage is that the tractor may work on side-hills without clogging or binding the treads. This is due to the semi-spherical shape of the two, joining raceways and the slight circular motion which they permit. In levee or side-hill vineyard work, this type of tractor has given very satisfactory results. Some of the unusual feats it can perform are shown in the illustrations. Each of the driving units is controlled by separate clutches, so that the tractor can be turned about in its own length.



At right: A driving unit, showing the ball bearings, and structural features

Never mind a little thing like a mud bath. Walk right in, turn around, and walk right out again

We Are Making Our Own Indigo Now

INDIGO is now being made from coal-tar in this country. At Midland, Michigan, one thousand pounds of twenty per cent paste are produced daily. All the tariff bills of this nation, commencing with the tariff of March 3, 1883, and including the tariff of October 3, 1913, placed indigo on the free list. Not until September 9, 1916, was a bill passed putting a duty on it. It was the first schedule that braved the anger of the German dye makers.

Tuning Airplane Wires

Ever notice how a tuning fork vibrates when you strike the corresponding note on a piano? Airplane wires are tuned on that principle now

ONE of the most common troubles on all airplanes has been the difficulty of correctly adjusting the tension of the wires used for bracing the wings. Some of the wires may be tauter than others, after a few hours' flying. There has been no ready means of correcting this fault. In consequence, great stresses have been thrown on some of the wires, while others suffered hardly any tension at all.

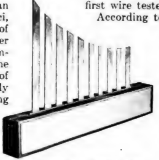
In tightening wires, mechanics rely entirely on their touch and hearing. They twang the wire with their fingers as they would the string of a guitar, listen to the note emitted and judge the tautness accordingly. The error average on the part of a skilled mechanic—after his own work had been tested with scientific instruments—was found to be about 30%.

© Int. Film Serv.

Airplane wires must all be at the same tension. Here a new multiple tuning fork determines pitch, hence tightness, and fitness for flying

It remained for an Italian aviation officer, Carlo Lerici, to hit upon a practical way of helping the mechanic over his difficulty. The accompanying illustration shows the simplicity and ingenuity of his device, which is really nothing but a multiple tuning fork.

A block of wood holds a series of metallic tongues, resembling those of a mouthorgan. The length of these tongues determines the musical note which they give off when struck, and this, of course, depends upon the number of times they vibrate in a second. Tuning forks vibrate in sympathy with strings of corresponding notes. A "G" tuning fork, for example, will vibrate sympathetically when held close to a piano on which the note "G" is struck. Similarly, when an airplane wire is twanged by a mechanic, and the Lerici "vibrometer" is held close to its end, one of the metallic tongues on the instrument will vibrate in sympathy. The mechanic has only to take note of the vibrating tongue and read the number of vibrations per second, written below it on the wooden base. He then takes the instrument successively to the other wires and "tunes" them by tightening or loosening them respectively, until their vibration periods correspond with that of the first wire tested.



The multiple tuning fork consists of reeds clamped in a block. Each end vibrates at a certain known pitch

According to the inventor, the chance of safety is increased fully 15% by making all wires equally taut. A series of tongues with 20-40 vibrations per second is sufficient for all the modern airplanes used in the war.

The same principle is currently used in determining the frequency at which electric generators are operating. Reedmeters are among the simplest existing.

A Metal Bottle-Cover That Never Wears Out

A METAL bottle-cover to take the place of the unsanitary paper cover has been devised by Harry W. Spangler, of Allentown, Pa. It may be used over and over again on any number of bottles. It fits around the neck of the bottle like the paper cover, but instead of being pried off, it is turned from right to left by means of a knife, held in the hand of the operator.

The knife is placed between three projecting points on the surface of the cover, these points forming a kind of groove. The cover may be used on fruit jars as well as on milk bottles or other glass containers, which need such a protection.

To remove the cover, a knife is placed between the points and turned

This New Self-Loading Wagon Makes Road Grading Easy

THE new device shown in the accompanying illustration, is designed to load and unload road-grading dirt three times as fast as any other similar type of machine. It consists of a light four-wheeled trailer, with a body pivoted about the rear axle. The bottom of the body is an endless belt, automatically driven as the trailer is pulled along by either a four-horse team or a light tractor.

The body is lowered at the front end to the desired angle by means of a worm gearing under the control of the operator on the trailer, who also controls a cutting edge much like that of a plowshare, located in front of the forward end of the conveyer belt. This cutting edge scrapes up the dirt and throws it back on to the forward part of the endless belt which carries it to the rear of the body and piles it up to the proper height until the entire body is loaded.

When this is done, the front end of the body is elevated to clear the ground. Then the trailer is hauled to the dumping place.

By tipping the body of the trailer to the rear, the load may be dumped all in one place or spread out in a thin layer by means of a hinged tail-gate

What Is Mean Sea Level?

If there were no disturbing influences the ocean would be of one equilibrium

By William Bowie

Chief of the Division of Geodesy, U. S. Coast and Geodetic Survey

How the Observations Are Taken

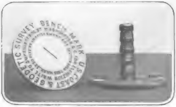
The leveling is done along the railroads because of easy transportation. The engineers ride on motor velocipedes. Note the sunshade and wind-brake. The leveling instrument, which was designed by an official of the U. S. Coast and Geodetic Survey, is considered the most satisfactory one in the world. Its tripod is mounted on one of the motor cars. On the second car there is placed a listing adding-machine on which the observations are recorded. Wonderful speed is attained. A party working in Michigan in 1916 ran 340 single miles of levels in one month.

WHEN one speaks of the elevation of a place, he has in mind the vertical distance above an imaginary surface. The surface is generally that of the oceans imagined to extend inland under the point considered.

If there were no disturbing influence by the sun and moon, the force of the winds and the varying pressure of the air, then the surface of the oceans at all places would be one of equilibrium. If lines of precise leveling were extended inland from the Atlantic, Gulf and Pacific assumed to be quiet to Chicago, for instance, and if the leveling were done absolutely without error, the elevations of their junction points would be absolutely the same for each line.

But the waters of the oceans are rising and falling in response to the forces acting on them, so in order to obtain an accurate starting point, a tidal station must be established, and the position of the water's surface with relation to a graduated staff must be observed each hour for at least a year. The average position of the surface of the water during the year will be almost exactly mean sea level.

Under the direction of Major E. Lester Jones, its superintendent, many such stations have been established along the coasts of the United States by the Coast and Geodetic Survey, and lines of accurate levels have been extended from them to furnish bench marks, which control the surveying, engineering and mapping done by the Federal Government, the States and cities and by private persons.



The bench marks are cemented into masonary or concrete

An elevation is the vertical distance above what would be the surface of the water if a sea-level canal were extended inland from the ocean to the bench mark.

Each line is run twice in opposite directions to guard against errors.

Between Stokes, He Knits for the Red Cross Unashamed

A BIG, burly, railway fireman has adopted knitting as his avocation. Between runs or even between shovels, Jack Ryder can be seen sitting in his cab placidly knitting away at a sock or a sweater for one of the boys "over there."

We see that he wears gloves while about his duties. Thus the article knitted is kept fresh and unsoiled.

This brave pioneer's example is being followed by other employees of the Burlington Road. So if your train is delayed, be sympathetic. Perhaps the fireman has dropped a stitch—back along the right-of-way somewhere.

Burlington fireman knits between times. Never a stitch does Jack Ryder drop

Wherein a Head and a Little Ingenuity Save Much Work

AN ice manufacturer of Hutchinson, Kansas, saves time and money in loading ice into refrigerator cars. He has built a kind of viaduct over two switch tracks, a street and across the roof of the Rock Island freight wharves.

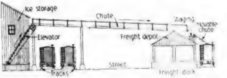
The viaduct is higher at one end, so that the two-hundred-pound cakes of ice, which are raised by means of an electric elevator, will slide by their own weight down to the car to be iced. At the lower end of the chute is a staging so that cakes coming down can be shunted to either side and dropped into different cars simultaneously. Formerly the ice was hauled on wagons and thrown in by hand.

Castor Oil Is Going Up

THE price of castor oil is advancing rapidly. No more children than usual have eaten forbidden goodies, but airplanes have developed insatiable appetites for this remedy.

The Government has recently been buying enormous quantities of this delectable article. So now the airplanes will get it for lubricating their engines.

At right: By utilizing a chain elevator and chute as shown, the ice maker saves much work



Below: The chute passes over two switch tracks, a street and the roof of a building

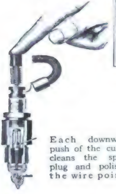
And Still They Come! Some Novel Uses, Comforts, Efficiency Devices, Conveniences and Economies for the Automobile and Motor Truck

This new type of headlight dimmer has an inside glass shelf which catches and diverts the glaring light rays

Even the pig now rides to market in state, occupying the rear of the farmer's automobile

In circle: A rocking heel support for the foot that operates the accelerator

A convenient new speedometer. Two screws quickly attach it to any cowl



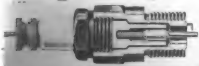
Each downward push of the cutter cleans the spark plug and polishes the wire points

A shutter which may be operated at will is held to the radiator with four small spring bolts

A powerful pumping engine of automobile construction

A float in the fuel tank connects a gage near the driver's seat which shows the number of gallons still in the tank

An inclosed socket for a flexible cord and trouble light which may be used on any part of the automobile that needs attention



A non-carbonizing spark plug that is supposed to burn off the carbon by its high working temperatures

A body hoist is shown to use in connection with passenger cars made from delivery trucks

These Are the Trapeze Artists Among Telephone Poles

TELEPHONIC communication has become so much a part of our everyday life that the new camps springing up number telephones as among the first military necessities.

In equipping Camp Gordon, near Atlanta, Ga., the telephone wires had to be swung across a long, newly made railroad cut. Speed was imperative. Instead of making a detour, poleless, aerial cross-bars were placed in position, held secure by guy wires fastened to poles running at right angles to them.

Four hundred telephones will be installed. The plant needed to connect these telephones with the exchange is large enough to do credit
a fair-sized town.

Crossbars held in position by wires attached to poles at the right and left of the area
the illustration

is cut out to conform to the shape of the top of the coat displayed and of the beholder's chin. Thus the man looking in the window sees himself wearing the suit on display.

Steel Wheels Are Becoming Popular

THE tendency to substitute steel for wood in the manufacture of wheels for automobiles and heavy trucks is not due to any desire to economize in the cost of the wheels, but is largely the result of the scarcity of good wood. In Europe, the wooden wheel has long been replaced by the steel wheel on trucks.

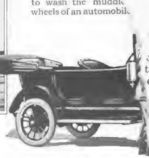
The most widely used wheel in England today is made from sheet steel. It is stamped in two parts. These are afterward welded together by an acetylene flame. The finished wheel looks almost exactly like a wooden wheel. There is an immense length of weld, however, which follows the mid-section of each spoke, so that this type of wheel is not considered a very good manufacturing proposition.

mitting oil as n
to the spring bolts
the steering knu

Below is shown
clever device in wh
to wash the mudd
wheels of an automobil

From three to six bolts are used, according to the size of the wheel.
se have cap nuts.
outer nave plate is
ose fit on the hub, so
t the wheel can be
ed off easily when
nuts are removed.
wheel can be supp
with a demount-
m if desired, but
very slight de-
or such rims in
l.

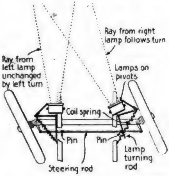
This motor fire-apparatus enables fire departments to cover a far larger area than was possible with old methods



Light Up Both Roads When Your Automobile Turns a Corner

BECAUSE an automobile in which he was riding one evening, went around corners so fast that it was dangerous, and because the front lamps were stationary and would not swing in the direction the car was going until it had turned completely, Frank E. Harvey of White Hall, Illinois, resolved that certain improvements in automobile headlights were necessary. Therefore, Frank E. produced a very simple and commendable invention.

The idea is to make at least one headlight turn, and that at the moment the steering wheel is revolved. Thus one headlight shines up in the new direction while the other continues to light the old roadway. In this way light is provided in the two places most needed when rounding a corner. The connecting rod between the front wheels supplies the motive power which moves the lamps. Two pins are made fast to this rod near each end, and the rod in its right-and-left movements causes one or the other of the pins to strike the arm of its bent rod leading up to the corresponding light. The illustrations show details. A spring keeps the parts taut and ready to respond to all impulses from the pins and rod.



One light points straight ahead, the other in direction car is going. Steering rod operates it

Below: Note how the light on left has turned with the wheels. Device prevents accidents

Two or three rolls will produce the warmest, brightest fire you ever kindled

Is Coal Scarce? Use the Newspaper Log.

THE only virtue no one has ever denied a newspaper, is that it burns well. But as fuel as well as in news, it has always been short-lived. Hence the newspaper log! It burns from three quarters of an hour to an hour and a half in any fireplace or stove.

Spread five sheets of newspaper, folded once, on a table, with the folded ends toward you. Begin to roll them into a tight roll. Before the first section is completely rolled, insert another section, and continue until the "log" is from two to three inches in diameter. Saturate each roll thoroughly with kerosene.

Mr. F. H. Albee of Hyde Park, Mass. is the inventor of this economy.

Night-Moths and Their Guiding Flames

Electric lights and gasoline flares to help the night-flyers land in safety

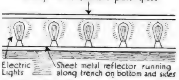
By Lieutenant Henry A. Bruno
Late of Imperial Royal Flying Corps, Canada

A NEST of the German machines that make frequent air raids on London when the weather is favorable was discovered by a solitary airman of the British Royal Flying Corps, who had been on coast patrol and, as often happens, lost his way in the darkness. From his report I write this description.

The aerodrome is protected by three anti-aircraft batteries, consisting probably of three guns each. There are five hangars, as the pictures show. How many planes they house is not known, but a rough guess places the number at about thirty. There are two large repair sheds at one end of the field, one of which contains a power house where electric current is generated.

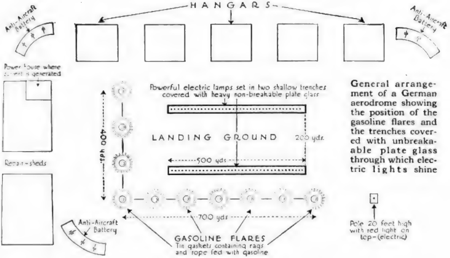
In order that squadrons which fly at night might find their home again, the Germans left nothing to chance. They filled ten buckets with rope and rags, soaked in gasoline, and arranged them as follows: Seven in a line over a distance of seven hundred yards to form the long leg of the letter "L," and three more over a distance of four hundred yards for the short leg. Near the first bucket, at the beginning of the "L," they erected a pole twenty feet high, with a red electric light on top. When these gasoline flares, as they are called, are lighted, they can be seen from a great height on a clear night. The aeroplanes land toward the short leg of the "L," and run inside and down the long arm.

This system is also used by the Allies; but



The electric lights within the trenches send up a bright glow

To assist their night flyers in making safe landings, the Germans have developed an ingenious system of illumination for their aerodromes. Within two line parallel trenches, electric lights



General arrangement of a German aerodrome showing the position of the gasoline flares and the trenches covered with unbreakable plate glass through which electric lights shine

the Germans, not content with the gasoline flares, dug two shallow trenches, both five hundred yards long and set two hundred yards apart inside the "L." These they lined with bright metal to serve as a reflector. A row of powerful electric lights was set in each trench. Over the top, heavy, unbreakable plate-glass was laid on a level with the surface of the ground. The pilot has only to glide down on top of the glass in order to make a good landing. If the power-plant should break down, so that no current can be obtained for the lamps, then the flares can be used.

The system betrays itself, however. The Allies fly over the illuminated aerodrome at night and drop bombs upon it. As a result, the Germans have had to use their lights only intermittently, and in some cases they had to abandon them.

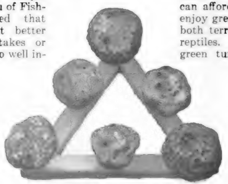
are placed covered with heavy, unbreakable plate-glass. The pilots have simply to follow the light and to land on the glass in safety. In addition to electric lights, gasoline flares are used

Raising Sponges on a Bed of Cement. The Sponges Like It

THINK of raising animals on slabs of cement placed on the bottom of the ocean! Of course we mean sponges; for sponges are merely simple animals. The Bureau of Fisheries has discovered that sponges like cement better than coral rock, stakes or copper wire—like it so well indeed that American sponge culture has grown from practically nothing into a million-dollar industry.

Cement disks and triangles have been used with great success in the sponge beds of Cuba and the Bahamas. The sponges readily attach themselves to the firm, clean surface and thrive on it. The disks, about ten inches in diameter and one and one-quarter inches thick, are composed of a mixture of one part of cement to three or four parts of sand. Two holes, about four inches apart, are made in each by thrusting an iron bar through the cement before it hardens. The disks can be made for less than two cents each.

The cuttings or seed sponges are attached to the disks in the manner shown in the photograph. A thin wire is generally strong enough to hold them securely to the disks. Each disk and triangle is numbered so that the Bureau of Fisheries knows the growth and behavior of the cuttings at all times.



Sponges growing on triangles of cement. Below: Thin wires attach the cuttings or seed sponges to the heavy cement disks

The pail has a glass bottom through which the fisherman can locate the sponges

Why Not Hooverize by Eating Lizards and Alligators?

MANY reptiles are edible and if sold under other names they would be palatable as well. Most of us eat diamond-back terrapin if we can afford it, and more of us enjoy green turtle soup. Yet both terrapin and turtles are reptiles. The eggs of the green turtle are said to be more nutritious than hen's eggs. Along the Amazon and Orinoco rivers in South America, turtle eggs form an important food item.

That lizards may be eaten seems more strange. Yet they were so popular a food in the Bahama Islands that they have been hunted almost to extinction. Florida alligators are said to be really delicious. Their appearance is certainly against them, but when carefully skinned, the flesh is no more repulsive looking than that of pork or veal. The taste has something of that of both fish and meat.

That Americans will ever eat snakes is more than doubtful. Just why they should be considered more offensive than eels or snails is a gastronomic problem. But large snakes are so scarce in this country that we shall probably never be called upon to conquer our prejudice. The pig and the oyster, both of which we relish, are unexcelled as scavengers by any reptile.

Gunning for Aircraft—How the Italians Do It

The pieces must be fired at their targets point-blank, just as a duck hunter fires at birds on the wing

WHILE it is true that no European strategist foresaw the important part that aircraft were destined to play in the present bloody conflict, it was at least realized that a man in the air had reconnoitering possibilities. Krupp even developed anti-aircraft guns to be carried on automobiles—weapons so clumsily mounted that they were of not much avail against a swiftly moving flying-machine. One of Germany's pioneer advocates of the military flying machine was Colonel Moedebeck. As far back as 1909, he predicted that only shrapnel could be effectively used against a prying air-scout—a prediction which has been amply fulfilled in the war.

How They Gun for Airplanes in Italy

Before the war no military engineer would have dreamt of mounting so heavy a piece on an automobile. Indeed, it would have been considered almost an engineering impossibility. But the necessity of attacking prying air scouts from constantly changing locations has made it absolutely necessary to achieve what seemed to be the impossible

How astonishingly anti-aircraft artillery has developed is evidenced by the accompanying photograph, taken on the Italian front. The earlier anti-aircraft weapons were rather small and were provided with elaborate range-finding devices. In a few months it was found that the pieces must be very much heavier than had been anticipated, and that they must fire at their targets, point-blank, just as a duck hunter fires at birds on the wing; there is no time for range finding.

As our photograph shows, the caliber has been increased enormously. The English and French have mounted heavy naval guns on field-carriages. Here we see an Italian anti-aircraft gun heavier than the piece which Krupp in 1910 designed exclusively for naval use, boldly mounted on an automobile truck. It is evident the truck is built for speed—evident because of the mud-guards.

The heavy shell fired by this Italian piece scatters a cloud of deadly bullets. Because of its power, the velocity of the projectile is maintained better than would have been possible with the feebler pieces with which Europe entered the war. Indeed, high power is necessary because of the altitude at which battle planes now fly for safety. Such a heavy gun has a practically straight path at high angle fire; the projectile reaches its target quickly. It is hard at best to judge the point at which an airplane will have arrived to be annihilated by a shell fired from below. Hence it is of paramount importance to reach that point as quickly as possible.

A good pilot can avoid being hit by suddenly turning and twisting as soon as he sees an anti-aircraft battery open on him. Established batteries, whose location can hardly escape detection, are therefore at a disadvantage. But a gun like that here shown, mounted as it is on a swift automobile, has a better chance.

Going, Going! The Steeple Bows to Business in Portland

HERE is the picture of a stately church steeple an enterprising photographer snapped just as it was on the verge of plunging to the street below.

The steeple, in the days of its fame, was part of the Taylor Street Methodist Episcopal Church, of Portland, Oregon. For many years this was the finest church building in the city. Then the expansion of the business district enveloped the site, and the congregation sought another location for its house of worship. The building that is now being razed will be supplanted by a business block, but one floor will be occupied by a mission, to comply with a requirement in the deed, which states that the property must always be used for religious purposes.

This is not an accident. A wrecking company is removing an old landmark in Portland, Ore. A skyscraper supplants it

Pasteurizer and Ice-Box Combined—A New Convenience for Milk-Dealers

A MILK sterilizer, pasteurizer and refrigerator all in one, in the space ordinarily occupied by an ice-box, that's the newest dairy appliance. Wouldn't you want it, if you were a small milk dealer? It consists of a metal-lined box, [illegible] pipes for both live steam [illegible] with the necessary tem- [illegible] Steam is raised in a [illegible] which one bushel of coal [illegible] urize two hundred and [illegible] milk.

[illegible] to pasteurize, the bottles [illegible] raw milk. Then metal [illegible] shown outside of the box [illegible] nying illustration, are [illegible] tops. Bottles, wood crates and all, are placed in the box, the cover is closed, and the steam is turned off gradually until the milk reaches the temperature of 142 degrees, at which it is held for a half hour. Then the steam is shut off and cold water is turned on until the warm water, which naturally rises to the top has time to run off.

No ice need be used if a cold water supply is available. In any event, a few pieces of ice placed on top of the cases will keep the milk cold until it is ready to deliver. The pasteurizer then becomes an ice-box, and one which will pay for itself in eighteen months by the saving made in ice alone.

The delivering of milk is attended with many hardships anyway. The dairyman must frequently arise at three thirty A. M. to milk and get his product started for the city in time for morning customers. Any devices which will lighten his work are welcome. They are all too few.

A small milk-dealer can pasteurize two hundred and fifty quarts of milk at a time

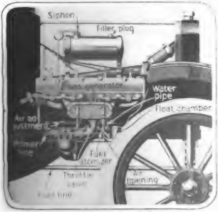
The Nasal Flute—You Blow Your Soul Into It

GOOD things come slowly, which explains why it required ten years of experimenting on the part of Aurion V. Chevers, of East Providence, Rhode Island, to devise the musical instrument which he is holding to his nose. It is made of wood and consists of a hollow chamber with two holes for the nostrils and one hole for the mouth. Musical sounds are produced with it by blowing through the nose, and the tone and pitch are varied by closing or opening the mouth. In this way many tones can be produced.


To play the flute, you place it against your nose and breathe as melodically as possible through your nostrils

A New Type of Hydro-Generator. It Moistens Gas Engine Fuel

THE new type of fuel-moistening device shown in the accompanying broken-away sketch is designed particularly for use on trucks. It consists of a special combined intake and exhaust manifold, carbureter and water tank. The water tank is mounted on top of the engine, underneath the hood, and feeds a small amount of water to a special nozzle which is incorporated in the carbureter float chamber.



Fuel and water vaporize against the hot manifold. Steam keeps down the carbon

The carbureter differs from that of conventional design, in that the float chamber and air-intake are in two separate pieces, several inches apart, the air-intake having a special bell-mouthed connection with the intake portion of the combined manifold. Between the air-inlet and the throttle valve, a special pipe leads directly to the intake manifold, through which the additional amount of air furnished, is controlled.

The water is syphoned from the tank into the special fuel nozzle, while the air is fed into the intake manifold through its own inlet. The fuel and water mixture striking the hot exhaust manifold is raised to a high temperature, the water turning into steam as it mixes with the air fed into the cylinders. As pointed out previously in the POPULAR SCIENCE MONTHLY, the admission of a small amount of steam with the atomized fuel tends to give greater power and to keep the engine cylinders free from carbon.

Canned Music for the Hindus in Their Native Language

AT Calcutta, talking-machine records are made in all the principal languages of India—Hindustani, Tamil, Telugu and Marathi. Though few natives of India, comparatively speaking, are rich enough to buy talking-machines, it is common for companies or individuals to tour the country, giving concerts with the machines. Before the war records in the native languages were—of course—made in Germany, but now they are produced only in India.

Living in a Giant Life-Buoy

Within are accommodations for
a dozen shipwrecked passengers

UNDERNEATH, the ship's engines vibrate steadily, the big propellers at the stern driving all on board nearer and nearer England.

Then comes a roar—a thud. All through the ship runs a great shudder. There is a violent rending and tearing, and up from the boiler-room comes a huge puff of smoke, the hiss of escaping steam, the shriek of dying stokers and the smell of fire.

There is no need for explanation. It is evident enough that a submarine has launched a torpedo only too effectively. Up on deck rush passengers and crew. Their one thought is the lifeboats. Has the ship lifeboats?

It has. They're of a new kind. They look like enormous tops all ready to spin. Inside are rows upon rows of seats. There are four or five of the giant boats (buoys they are) scattered along each side of the ship, next to the rail.

Into hatches in the uppermost side of these curious buoys (let's call them by their right name)—pour the people—so many to each buoy. The ship is listing rapidly. Also the fire seems to be gaining headway. Smoke rolls out of the stack and surges through openings in the deck and from cabin windows. At the far end of the ship water already reaches the rail.

Stragglers scramble madly about the deck. Suddenly hatches are clamped down on the lifeboats at the water-logged end of the great ship. The life-buoys half slide, half float off into the water, some of them dipping a fathom or two beneath the surface as a result of their momentum. In a moment, however, they bob up like corks.

Suddenly the looming bulk of the huge ship upends itself, water sliding in great sheets off of the exposed portion. Down the ship plunges, wallowing and eddying as it goes under, smoke and flame pouring from the superstructure. Stragglers and the life-

All that is left when the ship sinks, is a little colony of lifeboats, or rather, life-buoys, floating away from the wreck. Many ... can be housed ... tive safety

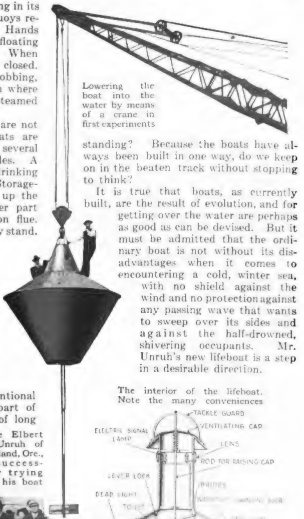
buoys still on deck are sucked along in its wake. Soon, however, the life-buoys reappear, and hatches fly open. Hands are put forth to gather in such floating bodies as come within reach. When quiet again reigns, the hatches are closed. Only a little colony of huge, bobbing, funnel-shaped buoys is to be seen where a short time before a great ship steamed along its course.

Inside the boats, the refugees are not wholly uncomfortable. The boats are roomy. People can be seated on several tiers of benches around the sides. A tank at the bottom provides drinking water and also serves as ballast. Storage-batteries and electric-lamps light up the interior. The periscope-like upper part of the craft acts as a ventilation flue. Here also the navigating officer may stand. It is impossible for water to enter as in an ordinary, open lifeboat. Even in rough weather, the refugees live in relative security. Electrically illuminated signal lights at the top, attract aid.

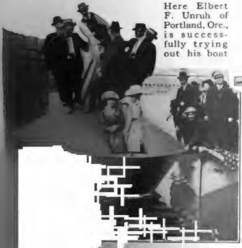
Thus Albert A. Unruh, of Portland, Oregon, would save life at sea. He has actually built one of his gigantic buoys, as our pictures show, and has demonstrated to his own satisfaction that the idea is sound.

Why do we cleave to the conventional type of lifeboat anyway? Is it part of the inertia that attends a craft of long standing? Because the boats have always been built in one way, do we keep on in the beaten track without stopping to think?

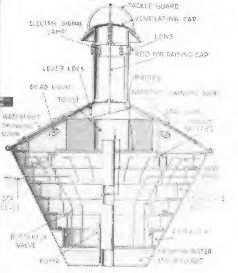
It is true that boats, as currently built, are the result of evolution, and for getting over the water are perhaps as good as can be devised. But it must be admitted that the ordinary boat is not without its disadvantages when it comes to encountering a cold, winter sea, with no shield against the wind and no protection against any passing wave that wants to sweep over its sides and against the half-drowned, shivering occupants. Mr. Unruh's new lifeboat is a step in a desirable direction.



Lowering the boat into the water by means of a crane in first experiments



Here Elbert F. Unruh of Portland, Ore., is successfully trying out his boat



The interior of the lifeboat. Note the many conveniences

"Hands up!" commands the burglar, but the teller's knee presses against a button. A phonograph and telephone send out the necessary warning to the police

The Thief's "Hands Up!" Is Answered by the Telephone's "Help!"

THE thief, face masked and pistol in hand, enters the bank and slinks up to the paying teller's window. "Hands up!" he commands. The teller does as he is ordered, sitting transfixed on his stool as the thief removes neat little piles of gold and silver from the window. In three minutes it is all over. The thief lowers his pistol, and, with the parting re[illegible] "Pretty [illegible] top," [illegible] the d[illegible]

[illegible] to the floor. In a moment he faces the teller again, this time with consternation written on his face. "How did you do it?" he asks.

"Pretty soft," mockingly replies the teller. "All I had to do was to press a hidden electric button under the desk with my knee. That little button caused a lifting device in the room adjacent to this to raise the receiver hook of a telephone. At the same time, a small-sized phonograph situated in front of the telephone transmitter repeated the message, "Help! Robbers! Send police to First National Bank!" Evidently the telephone girl heard it, for you were caught with the goods. By the way, you could have postponed your visit until to-night, but you would have been caught in the same manner."

How Our German Prisoners of War Amuse Themselves

GERMAN war prisoners, from the big German liner, *Vaterland*, are converting the large detention camp, located at Hot Springs, N. C., into a really pleasant place. They have built woodcraft houses to live in and made many curious and amusing things from materials gathered from woods and streams.

[illegible] a tree trunk. [illegible]ed wooden pegs

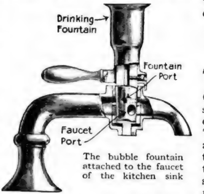
One of the curiosities of the camp is a big alligator, emerging from a hole in the ground. This was shaped from an old tree-trunk. One of the prisoners, skilled in woodcraft, has converted the stump into a strikingly lifelike reptile, its open mouth showing a double row of vicious teeth.

Safety First! Install a Bubble Fountain in Your Home

BELIEVING it to be unsafe for two persons to use the same cup, even in the home, Corrie F. Rudolph, of Washington, D. C., devised a bubble fountain to be combined with the sink faucet.

To drink from this fountain, you simply turn a horizontal lever to the left. This turns a two-way valve. One part of the valve rotates into position to connect the supply-pipe with the fountain, and you take your drink as the water bubbles over.

When you turn the handle-shaped lever at the right, the water is allowed to run out at the faucet for use in the regular way.



The bubble fountain attached to the faucet of the kitchen sink

No Automobiles or Bucking Bronchos for Him. He Rides to Town on His Ox

THE statement that the New York subway is the safest transportation line in the world is open to doubt. In South Glens Falls, New York, there is a one-passenger line which is the safest ever—and the oldest, by the way. Every morning one of the townsmen saddles his faithful ox and with switch in hand, he comes to the village for his mail and supplies. It takes him a few hours to make the trip, but while his neighbors in their automobiles pass him on the way, he does not envy them, for the price of gasoline and the danger of skidding around corners, to say nothing about head-on and rear-end collisions, worry him not.

The only expense connected with the maintenance of the one-ox line is the feed necessary to keep the animal going. Once you get its machinery in motion, you can forget about it, which is more than any automobile owner can say.


Of course, he never worries about arriving anywhere, but when to start is one awful uncertainty

Enlist in the U. S. Air Service

THE aviation section of the Signal Corps is looking for skilled American workers for service abroad. To bring up supplies and ammunition, and to construct and maintain the airdromes, squadrons of picked men are needed. All men who enlist will be given special training, according to their vocations, in work required for the air service.

The following kinds of skilled workers are needed immediately: Chauffeurs, automobile mechanics, engine repair men, office clerks, carpenters, radio operators, electricians, cooks, coppersmiths, expert photographers, machinists, stenographers, mechanical draftsmen, metal workers, motor cyclists, plumbers and painters. Applicants must be physically sound and of military age. Go to your nearest recruiting station and you will receive full information, or write to Volunteer Bureau 119 D St., N.E., Washington, D. C.


Viewing them in comparison with a thimble, emphasizes the diminutiveness of the seedling potato plants

The Wise Potato. It Refuses to Produce Unnecessary Seeds

POTATO seeds are so extremely rare that it is almost impossible to obtain them. Yet seeds of potatoes are plentiful. These facts seem diverse and antagonistic; they are easily reconciled. About twenty-five years ago potato balls were abundant wherever potatoes were grown, but in our modern intense cultivation the plants seem to have learned in many sections that it is not necessary to bring to fruition the tomato-like balls that should be the result of the bloom.

Potato seeds can be obtained from certain places, mostly outside of the United States. The potato propagator values these seeds highly, because from them, and preferably from the modern well-cultivated plant rather than from the primitive wild potato, the seed should be obtained for propagating new varieties. For the first year the plants are diminutive. The first year's crop of tubers is limited. These potatoes, about the size of peas or even smaller, are planted the second year. The tubers thus obtained are a little larger. Usually in the third year some will be found that are really worth while, and perhaps a new variety that is worth cultivating. Extensive correspondence on the subject has been carried on by Edward F. Bigelow, of Arcadia, Sound Beach, Connecticut, with potato growers in all parts of the country and has brought forth a great variety of claims and experiences.

Saving Man Power in Loading Freight Cars

THE tread-mill of the farmer boy's youthful days is now being employed in principle to lessen the number of men required to load freight cars. The device consists of nothing more than an endless belt-conveyor or stairway from the ground to a platform level with the freight car door.

This makes it unnecessary for the men to rush the incline as they must on the ordinary runway, and this in turn prevents them from becoming exhausted before the day's work is over. It also reduces the number of men required to load any given amount of goods, and the laborers so released can be employed for more vital war work.

The same kind of a tread-mill can be used for loading motor trucks. It is operated by a small electric motor underneath the platform. The motor can be shut off to save current when no loading is being done.

As the men must work quickly because the incline moves fast, more is accomplished.


The tread of the stairway is provided with small cleats to prevent the man and his hand-truck from slipping

Another Inventor Renders a Service to Humanity

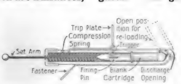
CONSIDER the picture on our right. In it we see a gearing-up attachment for a bicycle. It consists of a Y-shaped steel forging affixed at its three ends to the bicycle's frame. At its center revolve two sprocket wheels mounted on the same shaft. Over the smaller runs a chain from the pedal sprocket, and from the larger another chain goes to the sprocket on the rear hub. The net result is to gear up the machine.

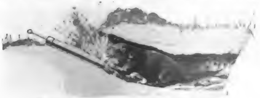
The attachment is supposed to increase a rider's speed by one-third, though lessening the former number of pedal revolutions required by one-half. But what about the immensely greater pushes on the pedals necessary? Such a contrivance may be useful on level boulevards. But even a small hill would put it out of business.

New attachment to gear up a bicycle. It also "gears up" the work you must do

Making the Pesky Gopher Commit Suicide

CALIFORNIA and other western states have two sorts of game that are always in season. One is the gopher, which is not a turtle, as he is in the South, but a burrowing pest; the other is the ground squirrel. Both are nuisances, and both are under the sentence of death when it can be executed. To help in carrying out that sentence, a western inventor has worked out a burrow gun. It has a cylinder containing a cartridge and firing mechanism, with a flat plate projecting from the side and taking the part of the trigger. When the gopher comes burrowing along, shoving fresh dirt ahead of him, he touches off the trigger, and the gun goes off. This is hard on the animal, but affords keen pleasure to the boy who has sat by the mouth of the fresh burrow and waited for the wily gopher to make its appearance.





Pushing the dirt ahead of him, the gopher sets off the trigger and shoots himself

Cutting Down Engine Weight

THE lighter an airplane is the faster will it fly and the farther it will go. Hence the lighter the engine is the more successful will the airplane be. The one follows from the other. In the development of the airplane motor into the remarkable machine it is to-day, this "weight efficiency" has become very high. It is little known how important was the part played in the development by a most simple device, originally invented for preventing the escape of gas from a breech-loading gun. This device is a cup-shaped piece of metal, now attached merely to the ends of the pistons of the airplane motor. Like its use in the gun, it checks the escape of the expanding gases. The greater the pressure of an explosion in the engine cylinders, the harder will the edges of the metal cup be pressed against the walls of the cylinders. Hence the less chance will there be of the gases leaking around the sides of the piston. The power in every portion of the exploding gases is therefore used, and none seeps away.

Wait until we get to transmitting power to airplanes wirelessly! Then a light electric-motor of great power can be used. New fields will open.

Balancing Crankshafts With Air-Turbines

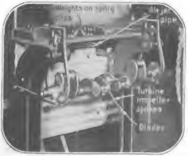
IN the early days, when the problem of the automobile manufacturer was to make a car run at all, rather than run economically and smoothly, balanced crankshafts were unthought of. But as the buying public began to demand cars with smooth-running engines, in order to reduce the unpleasant effects of excessive vibration, the automobile engineer had to devise some method of equalizing the power impulses transmitted to the driving shaft of the automobile at each cylinder explosion. And so he hit on the method of weighing all the pistons and connecting rods, and classifying them according to their weights, in order to be sure that the reciprocating mass of each cylinder was equal to that of any other cylinder in the same engine.

But balancing the crankshaft was a far more difficult problem, since it is in one integral piece which serves all the cylinders of the en-[illegible] In the old days, [illegible] way to dis-[illegible] the weight of [illegible] shaft prop-[illegible] all the cylin-[illegible] the engine was [illegible] it in static [illegible] which means [illegible] position that [illegible] ced on two [illegible] ges, one at [illegible] d, the shaft would remain in that position without revolving.

While this kind of balance was easily obtained by the trial and error method of turning the shaft and then cutting off portions of the crank-arms to make the shaft balance, it did not necessarily follow that either the engine or the shaft would be balanced when it was rotated, as when turned in the engine itself. Two equal weights on either side of the center will balance well even though one weight is all on one piston and the other all on another. Unequal distribution makes no difference. But, nevertheless, the piston to which the heavy weight is attached will push down with a harder force at each revolution than the one next to it. Hence the engine runs unevenly, even though the weights are balanced. Excessive vibration is set up, so that the engine wears out quickly, and the passengers are constantly jarred and shaken.

The Air-Turbine In Action

The crankshaft is carried on two pivoted stirrups, thus leaving it entirely free to turn about its axis without being affected by its mechanical means of rotation. The turbine wheel, which has six spoke-like arms, each with a flat blade at the end, is turned by a jet of compressed air issuing from a pipe on a level with the highest position of the blades. Two micrometers, in contact with the ends of the shaft, show the vibrations of the shaft if it is out of balance, and small weights are then attached to the shaft by spring clips as shown. These indicate at exactly what points metal must be cut off in order that the shaft may be balanced perfectly



The turbine when not in motion. Its mechanism is clearly indicated

The demands of the American automobile-buying public for smoothly-running cars has necessitated the development of some simple method of balancing the crankshafts of such engines at a rate which will not

interfere with the great quantity production for which our cars are famous. In handling this work, makes use is made of an air-turbine to revolve the shaft by means of a jet of compressed air impinging upon the surfaces of the vanes of an impeller, mounted directly on the shaft. One of the unusual features of this method is that the method of rotation does not affect the actual or apparent condition of balance of the shaft which is being tested.

An Antique Chinese Water-Wheel Irrigates a Modern Colorado Orchard

A COLORADO apple-grower irrigates his orchard with a water-wheel of the antique Chinese pattern. This primitive device supplies his fruit trees with ample moisture at a cost of only eighty-eight cents an acre, while his neighbors, who purchase water from an aggressively modern irrigation ditch pay four dollars an acre.

Water from a small dam furnishes the power which drives the water-wheel. The wheel is provided with buckets, which carry the water to the top, where it is emptied into the box-troughs, shown in the accompanying illustration. From the troughs, the water is distributed, as needed, to various parts of the orchard.

A Corrugated Hull Increases the Speed of a Ship

THE fact that corrugations in a ship's hull lessen its resistance to the water was discovered by mere accident. A. H. Haver, an English naval architect, was making various experiments in a Caws pendulum tank. This pendulum tank is simply a large tank of water over which a pendulum is suspended. To the bob of the pendulum a model of a ship is attached so that the swing of the pendulum draws the model horizontally through the water. The arc of the swing measures the resistance of the model to the water.

An experiment was made with a model having plain sides, and a certain result was obtained. Then corrugations were made in the hull of the model. Instead of reducing the swing of the pendulum on account of the increased wetted area, as was confidently expected, the corrugations increased it.

This proved that the resistance of the ship to the water was decreased in proportion as the wetted area was increased. The conclusion naturally followed that a ship with corrugated hull would possess a greater speed than one with a plain hull. It is not possible, however, to conclude that the increase in wetted area is the cause of the greater speed.

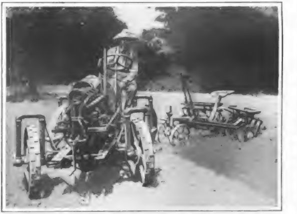
This water-wheel is provided with buckets, which carry the water to the top, where it is emptied into the box-troughs, from which it is distributed about the orchard

New Farm Tractor Driven by All Four Wheels

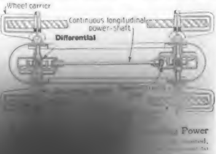
OSCAR D. Bowles, an inventor of Seelyville, Ind., has produced a farm tractor which is very hard to mire even in the softest kind of ground. It applies the all-wheel drive and steer of the French tractors, which haul artillery. The vehicle has four wheels, two at the front and two in the rear in the conventional arrangement. Each wheel receives some of the propelling power delivered by the gasoline-engine. If the two front wheels are mired in a soft spot and begin to spin because of lost traction, the rear wheels, if they are on solid ground, can pull the vehicle through.

Each wheel is carried on a universal joint, so that all four wheels aid in the steering. In turning a corner, the rear wheels track with the front ones, thus reducing the turning radius and making it simple to turn furrow corners without loss of time.

Although, as we have said, the all-wheel drive and steer is applied in all French military tractors, Mr. Bowles assures us that he has been work[illegible] on his invent[illegible] thirty years [illegible] well-i[illegible] ni[illegible] d[illegible]



The all-wheel drive illustrated, makes it exceedingly difficult to mire the tractor even in the softest ground



[illegible] Power [illegible] diagram.

Honey of Grapes—An Attractive Sounding Substitute for Sugar

IT would seem that almost every fruit but the lemon has been considered as a sweetener since the sugar shortage has become a problem. But few substitutes have been even usable.

The question of obtaining sweetening substances from plants and fruits has naturally been studied by scientists. The Italian Government, through its experiment station at Asti, has been experimenting with Honey of Grapes which is produced by a special process and a patented apparatus, discovered by a Professor Monti.

The substance is a grape sugar resembling honey. It is obtained through evaporation, and as it contains no water, it does not change in quality even if conserved for a long period. This is a great advantage over other sugars. It is especially useful in the preparation of jellies and preserved fruits as well as in the manufacture of fruit sirups for non-alcoholic beverages.

At Asti, only a small model of Prof. Monti's apparatus is employed, but a concentration of fifty-five per cent is obtained from grape liquor, which at the beginning has only sixteen per cent of sugar in solution.

Look into the Mysteries of a Mold with an Electric Trowel

OUT in Brainerd, Minn., lives Thomas A. Gatten, an expert molder, who fussed in the semi-darkness of an iron foundry, trying to get the sides of his mold just right. Sometimes he captured a little extra light by the bothersome expedient of holding a hand-mirror with his left hand while he worked with his right. Thousands of other men have done the same for years, and at the same time have made remarks—strong remarks.

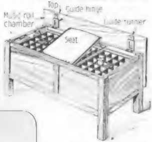
A small flashlight in the handle of the trowel enables foundrymen to inspect molds

One day, a bright idea came to Gatten while he was at work in some dark corner. Why not illuminate the mold by electricity? With this thought he set to work and invented a little electric lamp and battery to be sunk into the handle of his trowel—or into any other tool handle for that matter—that would furnish light where it was needed and when it was needed by the mere pressure of his little finger, as shown in the cut. Lights off—you have the ordinary molder's trowel, except that the end of its handle is decorated with a powerful little bull's-eye. Lights on—and you have a chance to see just what you are doing in a dark hole. Gone is eye-strain, inefficiency and the necessity for strong language. Mr. Gatten has given the world another of the little things that count.

Here It Is! The Adjustable Player-Piano-Bench and Record-Holder

THE combination piano-bench and record-holder shown in the accompanying illustrations is heavy enough to be perfectly rigid, so it will always remain in position when in use. Yet it is easily moved from its place and pushed back against the wall out of the way. This is done by means of casters, which are easily moved into place under the four legs, by pressure on a lever.

The seat slides down in-



Combination seat and record holder, with top covering-boards slid back and the seat in its position

to the framework, and is covered by the top covering-boards when not needed. When the seat is to be used, the covering-boards slide back and down, and the seat is raised to any convenient height. Inside the frame, there are partitions to accommodate sixty records. The seat slides along from one end of the frame to the other, so that the operator can select his record without getting up.

Inside the frame, partitions accommodate sixty records. Each record is easily reached

Raising Birds for the French Hunter

Pheasantries are maintained at great expense so that the bird-hunter may have his sport

The aristocratic pheasant is bred in much the same way as the ordinary unpretentious, domestic fowl

Photo by Jacques Boyer

THE pheasant, which is commonly bred in France for stocking the woods for the hunters, is raised, in a general way, like the common fowl, but it requires much more careful feeding. The pheasantry is located on some dry, slightly elevated ground not far from the woods where the birds are to enjoy their short span of life. If the breeder has not secured his cocks and hens during the hunting season, he buys the eggs for breeding from a reliable dealer. But if he has the birds, he is surer of results. The egg-laying period varies with climatic conditions, but ordinarily the hens begin laying in captivity about the middle of April, each laying about a dozen eggs during three weeks.

During the laying time the birds are fed plentifully on oats, barley, hemp seed and a mash made of ho[illegible] bread and [illegible]

[illegible] on some dry, slightly [illegible] from the shooting preserve

The eggs are marked with the date of laying and deposited, large end up, on a bed of bran in a wooden box. The eggs are placed under ordinary domestic hens for hatching.

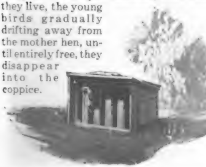
At the Rambouillet pheasantry, in France, the incubator chamber is a hermetically sealed compartment on the ground floor. Round or oval wicker baskets are arranged in rows in this chamber and buried to three-quarters of their height in the fine sand with which the floor is carpeted. The bottom of the basket is then covered with finely chopped straw and hay, and from fifteen to eighteen eggs are placed in it. A hen is placed over them and a cover intended to keep the hen on her job is placed over her. Incubation lasts twenty-four to twenty-six days.

In large pheasantries, artificial incubators are sometimes used when setters are lacking or to commence and finish the work. The best types of apparatus,

however, cannot equal the setting hen for results. Early in May hatching begins. Then for three weeks the chicks require great care. They are placed in a box filled with cotton wadding, and covered with a light quilt to dry, after which they are placed in the brooder. After about a week, they are placed in runs, in a grassy clearing, carefully protected against foxes, hawks and other marauders.

The young chicks must be carefully protected against foxes, hawks and other marauders

The daily bill of fare is carefully prepared. The first meal, on the day after the hatching, consists of ant-eggs. From the second meal this diet is varied by green food and a mash, of which the base is hard boiled eggs and stale bread. The moulting season, which often decimates pheasantries, is reached at the end of the second month. The breeder has now to redouble his vigilance in order to keep the chicks from damp and chill. Finally during the first two weeks of July the young pheasants are taken to the thickets or woods. They are carried at night, coop, mother hen and chicks, from the pheasantry to the spot selected, and there they live, the young birds gradually drifting away from the mother hen, until entirely free, they disappear into the coppice.



Hens are used to hatch out the pheasant eggs. Incubators have never been so successful

If You Can Stop An Automobile, You Are Fit to Run One

RUNNING an automobile through traffic is like swimming in deep water. Don't do it until you are so sure of yourself that all danger of panic has gone by. And always expect the unexpected. Leave your family or friends at home on those first few rides.

As your initial lesson, after you have learned the names, and above all the potentialities of the various levers, learn how to stop. Of course, as a preliminary, you must start, but that can be at your leisure. Make a dozen—or even a hundred attempts to bring the car to a standstill until you have gained confidence. Then adventure along some quiet, unobstructed road.

After you have received some instruction about the general mechanism of the car, practise stopping suddenly before reaching imaginary dangers along the road. Don't wait for this lesson until a child, a chicken, an absent-minded saunterer or some other irresponsible live thing sends your brand-new knowledge helter-skelter.

Measuring distance accurately is the most important feature of driving. Draw two lines across the road fifty feet apart. Then, going at the rate of twenty miles an hour, apply the brake and see how long it takes you to stop the car. When you discover how much over the fifty-foot line your automobile goes, you realize the necessity for the driver's first rule—caution.

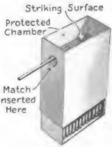
This trial also teaches you what speed is safe in approaching railroad crossings and intersecting streets, and how near you can go to traffic before applying your brake.

Use This Match-Box to Light Your Cigar in the Strongest Wind

NOW comes an invention, patented by George Frank Waugh, a private in the United States Army, which seems to solve the difficulty of lighting a match in a wind. The device is simple. A small, round hole is made near one end of the cover of an ordinary match-box. Some abrasive material is pasted on the corresponding end of the tray itself.

This match-box provides a small protected space in which a match can easily be lit in spite of drafts

In order to light your cigar, slide open the cover of the box until the hole is free, insert your match in the hole and strike it on the abrasive material on the end of the box. The released end of the cover provides a small walled-in space, in the shelter of which the cigar can be quickly and conveniently lit.



Cook With Acetylene Gas on the Farm

THE country housewife need no longer use an old-fashioned range, even if her home knows not gas or electricity. The home acetylene heating apparatus can be used, with excellent results, for cooking. There is no odor from the flame. The food is just as untainted as if it were cooked over wood or coal.

Since the acetylene stove need be lit only when in actual use, there need be no superfluous heat in the kitchen during the greater part of the day. Burners are so constructed that any desired amount of heat is obtained without delay.

Some accessories for the household are instantaneous water-heaters, flame spreaders for heating flat-irons, broilers and a gas-heated flat-iron.

Cultivating Nerve by the Rope Bridge Route

WARD W. BEAM, a Quaker City physical culturist (of course he is a "professor"), has his own ideas about the right way to make the body subservient to the will. First and foremost he cultivates "nerve," by teaching his students to do seemingly impossible feats.

He takes his pupils into the country, selects a suitable stream and builds a rope bridge across it. One rope is a hand support and the other a precarious foot-bridge. He tells his pupils to cross the stream via the rope route. Once started, they have to keep going or get a bath. Both women and men are able to negotiate the crossing with comparative ease after they have once done it. As Professor Beam assures them, it is only a question of "nerve."

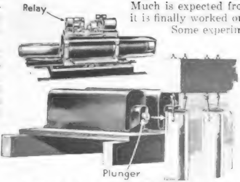
Ward Beam, a physical culture teacher, makes his pupils cross streams on a bridge which consists of two ropes, so that they may acquire "nerve"

The Tintinnabulation of the Electric Tubes—Playing Chimes by Electricity

EXPENSE is the principal reason why more church chimes aren't heard—expense and the difficulty of getting heavy bells up into a steeple. A Chicago company, however, is manufacturing chimes made up of heavy tubes instead of the usual bells. A whole set of fifteen or twenty may be stowed away in a small space and erected with comparative ease. Tube chimes may be tuned more closely than bells.

Instead of the customary ropes which actuate hammers, the tube chimes are played by electromagnets controlled from a keyboard. The plungers, forming part of the electromagnets, strike their respective tubes sharp and sudden blows when energized.

The keyboard used is about the size of a suitcase. It can be located anywhere inside a church, even next to the pipe-organ keyboard if desired. The keyboard belonging to the chimes does not carry power currents, relays being interposed to perform this operation.



The keyboard of the tube chimes may be placed beside that of the church pipe-organ

U. S. Government Tested Much War Machinery in 1917

ACCORDING to an annual report just issued, the U. S. Army's Board of Ordnance and Fortification has experimented with a number of interesting machines during the past year.

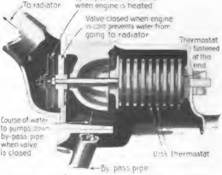
For instance, the production and trying out of a self-propelled, oil-electric, armored railway car was commenced. Tests are under way of the Hammond radio-dynamic system of torpedo control. For the purchase of this system, if it proves satisfactory to a Board of three Army and three Navy officers, and the President, Congress some time ago appropriated $750,000, and an additional $417,000 to buy material for and make a sample unit. Much is expected from the system when it is finally worked out.

Some experimental gun emplacements have been built and put through many tests. Portable searchlights for the field artillery have been devised. Flares and star bombs for trench use were decided upon. Pontoon boats are to be propelled by the outboard type of motor in as many cases as possible. This motor is already familiar through use on ordinary rowboats. Radio sets, cameras, turntables for siege artillery, illuminated compasses and many other new conveniences for military use are being developed. Trinitrotoluol, the powerful explosive, gave demonstrations of its powers at the Sandy Hook proving ground. Several submarine detectors are shortly to be tried out on actual submarines. Our own U-boats will be used for this purpose and a wide range of experiments and tests will be made. Investigators have been working on the subject all summer, and it is hoped to turn out perfected machines shortly.

Keep Your Engine Efficient

This new thermostat cuts off the radiator when it cools the water too much

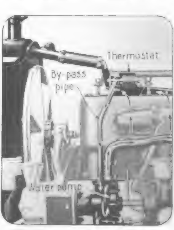
ONE of the large makers of motor trucks in this country equips all of his truck engines with thermostats (thermometers that control the temperature of hot fluids) in the water line to control the heat of the water in the cylinder jacket, so that at all times the engine is operating at its most efficient temperature. This condition is especially important in cold weather, when it is difficult to start the engine.



The thermostat keeps the engine always running at its most efficient temperature

The thermostat is controlled entirely by the temperature of the water in the cylinder jacket and operates to by-pass some of the water back to the pump, instead of allowing it to be cooled in passing through the radiator in the usual manner. This is only done when the water is cold, as when starting, and is equivalent to using the same water over and over again without sending it through the radiator to be cooled. As soon as the temperature rises, the thermostat automatically closes the by-pass pipe and allows all of the water to go through the radiator so that the engine will not eventually overheat.

The thermostat consists of a series of ten metal disks mounted on a shaft fixed at its rear end to the water system casing on the top of the cylinder block. The other end of the shaft carries a valve which seats on a special cage inside of the water space. This cage is open at the end nearest the disks and is provided with an opening leading to a by-pass pipe direct to the engine water pump as shown. When the cooling water is cold, the disks are contracted and the valve in the end leading to the radiator is closed, thereby permitting the water to flow down the by-pass pipe into the pump and be circulated without being cooled by passing through the radiator. As the water heats up, however, the disks expand and the end of the shaft is forced forward, opening the valve leading to the radiator and at the same time closing the opening to the by-pass. When this occurs, the water passes through the radiator in the regular manner. As the temperature of the cooling water varies, the thermostat alternately opens and closes the by-pass so that the temperature is kept at its most efficient point.



The thermostat is controlled entirely by the temperature of the water in the cylinder jacket

No more need the electric starter whir and whir around in an attempt to start a frozen engine. With this contrivance, enough warm water should remain in the engine jacket to make starting a relatively easy operation.

A Novel Tea-Table Made From a Mill Stone

SINCE farmers now rarely bring their grain to a small local mill to be ground, the old millstones have gradually settled to the bottom of the rubbish heap. Many have been broken up, but the lovers of antiques are now rescuing the remaining ones.

In the illustration is shown an old stone found in a New Hampshire mill. It is now used as the tea-table. Remembering the Biblical warning that "on whom it shall fall it will grind into powder," it is set on a stand of rocks which have been firmly cemented together.

Benches or individual seats of stone are appropriate for use with such a table.

An old millstone used as a tea-table. The stand is made of rocks cemented together

A French Inventor Improves the American Harvester

ERNEST BONNET of Nonancourt, France, has made important improvements in an automotor harvesting machine, which facilitate cleaning and moving the machine from one place to another. The working parts of this new harvester may be completely uncoupled. The front tractor is attached to a trailer which comprises a harvester, combined with connections for transmitting rotary motion from the motor to the trailer and power-control mechanism on the trailer.

Power is so transmitted that the driver can unclutch the driving wheels for halting the vehicle, without stopping the operation of the working parts. The reverse effect can be obtained, and the driving wheels can be made to carry the vehicle forward without setting the other mechanism operating.

The traction wheels are hung on vertical pivots with a bridge connecting them. This bridge carries a differential gear. A divided axle communicates movement from the differential to the traction wheel. Universal joints are provided coinciding with the vertical pivots of the wheel. Transmitting mechanism for communicating rotation from the motor to the differential gear completes the combination.

Will machines, such as this, shortly be used on our great Mid-western farming lands? Assuredly tractors, in one form or another are to work great changes in our agricultural methods in the very near future.

The working parts of this new harvester may be completely uncoupled. The engine in front drives the whole mechanism

Your Out-door Shooting

Throwing clay birds as a boy "scales" flat stones adds new zest to trap shooting

CONSIDER the small boy who finds a nice, smooth, flat rock. If the chances are not more than even for breaking a window—and getting caught—he curves index finger around one side of its periphery and lays thumb against the other. Then with a long swing of his arm, keeping the rock horizontal, he sends it scaling flatways through the air. In its long, spinning, steady flight it travels more smoothly and farther than any round rock.

The Darton hand trap is simple to use. It is speedy; shooters must be alert

Since the saucer-like clay bird displaced the round and costly glass ball as an artificial target for the shotgun, the throwing machinery or trap has closely followed the lines of the small boy's hand and arm. The sole exception is the sort in which the bird is laid on a flat, steel plate, to be swept off by the swing across it of a rubber-faced steel arm.

The Darton hand-trap, shown in the photographs, is the simplest of all the devices yet put out for the purpose of sending the flat, clay saucer sailing on its spinning course through the air. It approximates uncannily the two fingers and the arm of the original flat, disk-throwing machine operated by the small boy.

The clay bird is grasped by the extended metal fingers

The bird is held between a thumb and forefinger made of heavy wire, set at the end of a slightly flexible, wooden handle, with grip shaped for the hand. One finger is longer than the other. In one form, the two parallel wires forming each finger, continue parallel, and the saucer which is a 4¼-inch hollow, clay disk, is pushed in between the fingers from the front—a "muzzle-loader," as the inventor terms it. In the other form, the top wire of each pair is bent outward so that the saucer can be dropped into the grasp of the fingers from the rear. This obviates the necessity of pressing the bird home against the resistance of the fingers.

The two, wire sidebars to each finger are so spaced as to grip the edge of the target firmly, and the two fingers terminate at the rear end in a metal socket screwed to the wooden handle. When the bird is placed horizontally in the fingers, and the handle is given a powerful full-arm swing, with a snap at the finish of the swing, the bird is thrown out of the grip of the fingers by the centrifugal motion. The longer finger yields to the pressure, letting the bird slip out of the grip and roll along this finger, giving it the spinning motion essential to steady and long flight of a flat object.

The fingers are considerably longer than the portion necessary to grip the target, affording a track along which the bird rolls when driven out by the centrifugal motion, and when a spin is imparted.

For the lover of a solitary game in shooting, the inventor adds a stout elastic

loop to the handle of the trap, by which it may be hung across the shoulders. Then he holds gun in left hand, swings mightily with the right, holding the trap, drops the trap at the end of the swing, grasps the fowling piece and "has at" the flying bird he has just thrown. As the bird leaves any of these traps with the speed of about 150 feet a second, even though it falls off rapidly, the shooter has to hustle to get into action before it is out of range.

Two other traps are in use for throwing the birds by "hand." One of them, the Ping Pong, is similar to the Darton, save that the bird is held in the regular steel, rubber-tipped fingers of the larger variety, bolted to a wooden handle. This takes more power than anyone but a full-grown man can develop. The other is operated by a powerful spiral spring which swings the throwing arm like the big set position traps, when the finger releases the trigger holding it. This requires a little effort to set, and is not entirely safe in the hands of the inexperienced because of the great force with which the spiral spring throws around the arm and the fingers that hold the bird.

So is field practise made available anywhere for the seasoned lover of the scattergun.

The bird can leave one of these hand-traps at a velocity of 150 feet per second

This hand-trap has a powerful spring. It should not be operated by the inexperienced, as it can deliver a terrific blow

How to Waterproof Your Boots

TALLOW has been used a great deal for waterproofing boots. But authorities on the subject of leather say that tallow is not the best thing to use because it contains a high percentage of fatty acid which is bad for leather.

Any good, heavy grease will make leather boots waterproof, if the leather is thoroughly soaked in it. One of the best substances to use is a belt preservative. The most important point in waterproofing boots is to use something that will fill the small openings and stitch holes. Belt preservative will best accomplish this result.

Boots should be well washed before being treated. They must be warmed, but not allowed to get too hot. Leather will stand no more heat than will your hand. The preservative is then heated and painted on the warm boots. They are kept warm until the oil has penetrated the pores of the leather. This process may be repeated several times, care being taken to work the preservative well in around the stitches. Boots cannot be polished after being waterproofed because the leather is left much too soft and porous.

An Electric Lantern Which Will Stand Rough Use

AN electric lantern specially constructed to withstand hard knocks and rough handling is shown in the accompanying illustration. The frame is made almost entirely of aluminum, and the bulb is set far back against a large reflector so that it is well protected. Two dry cells furnish the current for a brilliant light. A large strap with hooks is provided so that the lantern may be conveniently carried by suspending it from the shoulders.

This handy lantern for camping uses is constructed to withstand unusually hard knocks

Heating Low-Grade Gasoline with Exhaust Gases

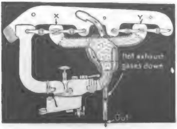
ONE of the simplest of the many heating devices to aid in more thoroughly vaporizing the present low-grade fuel used in automobiles, consists of two ham-shaped castings which are bolted together over the Y-shaped portion of the intake manifold in such a manner as to leave a small space between the manifold and the exhaust. This intervening space is filled with hot exhaust gases from the engine by means of a flexible metal tube tapped into the exhaust manifold at the top, and then exhausted down below the bottom of the engine-pan by means of a similar piece of flexible tube tapped into the bottom of one of the castings.

In passing through the space between the castings and the manifold *Y*, the exhaust gases heat the *Y*. The incoming fuel is raised to such a high temperature that it is broken up into very minute particles which are entirely consumed by the cylinder explosion.

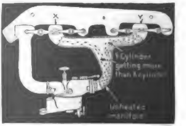
The fuel so heated has then no tendency to condense on the manifold walls, which happens when the walls are cold. Instead, it diffuses itself equally between both arms of the *Y*, so that all four cylinders receive almost exactly the same amount of fuel, an end much to be desired.

Yawning Fishes. Evidently They Have Brains Enough to be Bored

DID you ever see a fish yawn? Mr. Richard Elmhirst, an English biologist, tells us that yawning is a common habit of cod, saithe, cobbler, plaice and various other kinds of fish. From his description the piscatorial yawn is very much like the human yawn, except that it is done under water. He says: "From numerous observations I am led to think that this action of fishes is a real yawn, and serves the true physiological purpose of a yawn; that is, flushing the brain with blood during periods of sluggishness. The conditions conducive to yawning are a slight increase in temperature, and, I suppose, the accompanying diminution of oxygen."



At left: Piping exhaust gases through casting surrounding intake manifold vaporizes low-grade fuels thoroughly. At right: Uneven gas-distribution as ordinarily encountered



FOR PRACTICAL WORKERS

Using a Piece of Wool to Detect Dye in Jam

SOME of the jam sold at the present time is dyed to give it an attractive color. Happily, it is easy to find out whether or not the jam has been treated

A bit of cotton dipped into dyed jam will retain the color through many washings

in this way. The first step is to mix a little of the suspected article with some water, then dip into it a piece of clean cotton wool. If the jam has been artificially colored, the stain on the wool will be very difficult to wash out. On the other hand, when the jam is pure, the stain can be rinsed away very easily.

Rubber Roofing Used for Packing in Steam Joints

IN case of emergency—and in the regular course of repairs for that matter—ordinary rubber roofing makes an excellent packing for steam joints. As a gasket between flanges on a steam line, for cylinder head, or for steam chest work, it lasts just as well as regular packing and shows no more of a tendency to blow out. Moreover it is a great deal cheaper.

Deodorizing Naphthaline for Medicinal Purposes

NAPHTHALINE has such a disagreeable odor that its use in medicine and surgery is considerably retarded, and it has been found out by experience that the mixture of camphor and various other deodorants with it produces only a temporary benefit. Mixing the naphthaline with some benzoin and subliming the mixture, frees the sublimate of naphthaline from the tarry smell. Moreover, the naphthaline is given a pleasant odor. This is not the case when it is simply mixed with tincture of benzoin or benzoic acid.

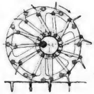
Trick of Brushing Ten-Cent Piece from the Palm

STRETCH out your hand and place a dime in the center of your palm Give your chum a whisk broom and ask him to brush off the dime. He will probably laugh and ask "What's the idea?" But let him try it. He can brush for half an hour without removing the coin. A dime cannot be brushed from the center of the palm with a whisk broom unless it is "dug out" with a corner, which would not be fair play. Try it for yourself first and see—then try it with your friends. If anyone wishes to examine the dime after the stunt, tell him that even the dime says the joke is on him. To prove this, turn the coin over to show the printed words: ONE DIME. Cover up the E and the Di. The remaining letters spell "ON ME."

The coin cannot be swept out

Positive Traction Wheel for a Motor Plow

WHEN an agricultural tractor is used for pulling plows in tenacious soil, it is necessary to augment the traction obtained by the normal adhesion of the loaded traction members and the ground with the added impulsive force secured by cleats or spurs that dig into the soil. A novel form of traction member used on a motor-driven plow of Italian design is here illustrated. It provides positive traction and is at the same time relatively free-rolling because the blade members that dig into the ground enter and leave the earth in an almost straight line. The ordinary form of fixed spur or cleat must strike the ground at an angle and push the earth back out of the way as the wheel rolls forward. This calls for the expenditure of power and of course reduces the efficiency of transmission. To have the spurs engage the ground with an almost direct thrust and leave it with a direct upward pull is a very desirable end to attain because there is a minimum displacement of earth with its attendant loss of energy.



The spurs enter and leave the ground vertically

There is no power lost in lifting dead weight with the grippers as they work vertically

The mechanism by which the traction-augmenting blades are made to engage the ground with minimum loss of power is very simple and the principle involved may be clearly grasped by a study of the diagram. The spurs are in the form of drop-forged steel bell-cranks, swinging on fulcrum-pins carried between the two halves or side plates comprising the wheel. The actuating cam is attached to the fixed axle on which the wheel revolves. An eccentric strap having a plurality of connecting rods extending to the spurs, surrounds the cam or eccentric, and as the wheel revolves the spurs are rocked back and forth on their supporting pins, the motion being so proportioned that when the traction blade is about to engage the ground it is approximately perpendicular. Some such form of positive traction member is almost essential because the plows are mounted at the front and are pushed, not pulled. The traction-wheel, being on the same side as the plows, must necessarily work in the loose, soft ground of the furrows.—VICTOR W. PAGÉ.

Things To Be Remembered When Washing an Automobile

NEVER try to wash the car out in the cold. Take it in where it is moderately warm; then use clear, cold water. The cold water will help to harden the varnish on a new car, thereby preventing abrasion. If you use any soap at all, use only a limited amount, as free acid or alkali tends to soften the finish. Soak caked mud thoroughly with a small stream of water until the mud runs off with the fluid. Don't rub the mud off. If it has frozen to the finish, keep on applying cold water until it runs away. Never use hot water. In drying the car, avoid using a chamois that contains any sand or grit. If polish is necessary, use a good grade, then rub off the surplus.

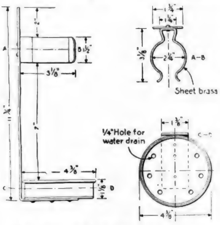
Never allow a car of fine finish to stand in a barn or stable where animals are kept. The ammonia of the manure will check and ruin the gloss.

Don't keep the garage too hot. This caution applies to what is probably the greatest enemy of the fine body finish. In an overheated garage, the body of the car gradually expands; then if the car is suddenly exposed to extreme cold, the result is plain. The sudden contraction in cooling causes the paint to check.

A Convenient Metal Holder for Milk Bottles

JUST where the milk bottles go and what becomes of them is difficult for some housewives to determine. The illustrations show a very handy little receptacle for the bottles. It can easily be made in any home workshop. The base is manufactured out of an old coffee can cover, the top or spring catch portion being simply an old piece of sheet brass, moulded or formed over a round bar. When the old bottle is empty, it is slipped into the device and the milkman on his round replaces it with a full one. The holder can be placed anywhere on the side of the house, or near the door, low enough so that it can be easily reached, yet high enough to protect the bottles from accidental upsetting or from being knocked out.—F. W. BENTLEY, JR.

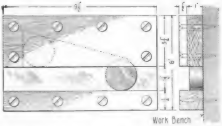
The bottle of milk is easily set in holder



The sheet metal parts are made the correct size to hold an ordinary quart bottle

A Work Bench Clamp to Hold Boards for Planing

THIS very handy clamp or vise is easily made of oak or other suitable, hard wood. It consists of three pieces and a disk. The pieces are 9½ in. long; one is 1¼ in. wide and 1½ in. thick; the base of the other part is 3½ in. wide and 1 in. thick with a cap of the same width and ½ in. thick. The disk is 2 in. in diameter and slightly under 1 in. in thickness. A wedge-shaped notch is cut in the piece that is 1 in. thick, so that the larger part admits the full size of the disk, the smaller part sloping down almost to a point. The pieces are fastened to the bench top as shown, with a space between them of 1¼ in., and with the disk in the notch.



The disk rolls on the sloping part of the groove and clamps the board by pressure

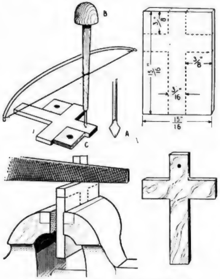
It is apparent that when a board is placed edgewise in the open space, while the disk is in the larger opening of the notch, it will be free, but upon pushing it forward the disk will roll against the sloping part, and wedge or clamp it. The more pressure applied, the tighter will be the grip on the board. When it is pulled back, the action is reversed and the board is easily withdrawn.—ROBERT HANLEY.

Solution for Cleaning Polished Brass Quickly

THE following solution will clean brass faucets very quickly, without injury to the hands or the metal. Put 1½ oz. of alum in one pint of boiling water, and rub the solution on the brass surface with a cloth. The stains, as well as the tarnish, are quickly removed. The solution is inexpensive and easily made.

How to Make a Watch-Charm of Marble, Agate or Granite

A SMALL cross made of marble, agate or granite makes an attractive watch-charm. The process of shaping it



Dimensions of the cross to be made; also how it is to be drilled and cut from marble

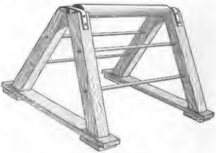
is very simple. It can be done with a file. First flatten the piece from which it is to be cut, by rubbing it on a sand stone; then mark the pattern on the sanded side with a file point. Next file to your lines with a flat-faced file, holding the piece in a vise. Bore a hole in the upper portion of the finished cross by means of a fiddle drill. A piece of a darning needle flattened and pointed as at *A* serves as a bit. The butt end is also flattened, so it will not [illegible] imbedded in the end of a [illegible] A small, loose-fitting [illegible] a hand rest and [illegible] turn. The bow is a [illegible] ends are joined by [illegible]ing. With the hand [illegible] pushed back and forth, [illegible] will soon drill through [illegible] it wet as you drill. [illegible], tacked to the bench, [illegible] firmly. The charm [illegible] rubbing with fine-grained marble and finally given an oil rubbing with a piece of felt. Any amateur may attempt this dainty piece of work in all confidence. Ordinary carefulness is the chief requirement that makes for success in making this attractive watch-charm.—JOHN L. DOUGHENY.

A Small Steam Engine Used as an Air Compressor

IN a small machine-shop some metal tanks were ready to ship when the order came to test them under 60 lb. air pressure. There was no air compressor at hand and no time or money to get one. But the tanks were all tested that day just the same. There was in the shop a 6-horsepower steam engine undergoing repairs. This engine was belted up to the line shaft with a piece of pipe between the steam chest and one of the tanks. A gate valve was put in this line and a pressure gage was attached to the tank. Then the engine was started, and air was pumped into the tank until the gage registered the 60 lb. In this way, each tank was thoroughly tested at no great cost.

A Portable Board Roller for Circular Saw Feed

THE illustration shows how a wheelwright used a discarded wringer-roller in the construction of a board slide or rest, used in conjunction with a circular saw. The rubber of the roller evidently



Rubber roller from a wringer used on a special horse to make a board roller

exercised brake enough on the boards to prevent sudden spurts during the process of sawing.—JAMES M. KANE.

Disappearing Clothes Rack for the Closet

THE materials necessary for the disappearing rack are: 2 single-sheave pulleys, one double-sheave pulley, 3 screw hooks, 15 to 20 ft. of light rope, and

Arrangement of pulleys in a closet for hoisting a pole from which clothes hang

a thin pole about 4 ft. long (a broom stick will answer very well). The pole is fastened by two of the screw hooks placed in the ceiling, about 3 ft. apart. The double-pulley can be fastened near the ceiling at a convenient end of the closet. This pulley is to act as a guide for the ropes. The stick is supported at each end by a rope; the other end of the rope passes over one of the single pulleys, then over the double pulley and down to a convenient distance for hoisting and lowering the rack. In order to prevent the rack from tipping or tilting to one end, the ropes should be knotted together at such a place that when the rack is lowered to the right height, the knot will just strike the double pulley. In order to hold the rack in place, the ropes may be wound around two nails placed below the double pulley.—F. W. BUERSTATTE.

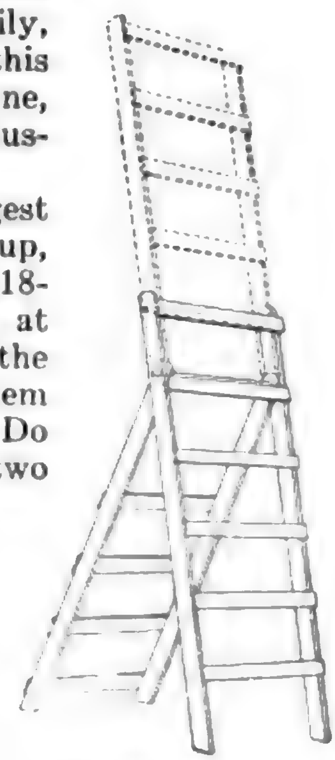
A Combination Straight and Folding Step Ladder

TO make a ladder that can be used either as a straight ladder or as a step ladder, the following material is required:

2 pieces of 1 by 3-in. straight-grained wood, without knots, 6 ft. long.
6 pieces of the same 18-in. long.
2 pieces of the same 5 ft. long.
3 pieces of the same 16-in. long.
2 pieces of stout broomhandle 18-in. long.
A quantity of 8 or 10d nails.

About ½ in. from one end of each of the four long pieces bore a hole, through which a broomhandle will pass fairly easily, and 1 ft. back from this hole bore another one, as shown in the illustration.

Lay the two longest pieces with edges up, and nail on the six 18-in. rungs, beginning at the end nearest the holes and placing them about a ft. apart. Do the same with the two shorter pieces, but in this case begin the rungs about 2 ft. from the ends with the holes in them.



This folding ladder is in two parts

Next place the short ladder within the long ladder so that the holes are in line. Slide one of the pieces of broomhandle through these holes to form a pivot. Fasten the pivot to the large ladder with a small nail to prevent it from slipping out, then allow the small ladder to swing free.

With the addition of a short length of rope or chain placed between the two sections to prevent their spreading, the step-ladder is ready for use.

To convert it into a straight ladder all that is needed is to detach the stop-chain, swing the short section up until it is in line with the long section, and slide the other piece of broomhandle through the holes.

A Rustic Seat Made from an Old Tree Stump

It was merely as a matter of convenience that the largest limb of a tree which was felled, was sawed off nearer the

The shape of this tree made a very simple task to construct a seat from its stump

ground than were the two smaller branches. However, this at once suggested a seat, which was very easily made. A piece of board was placed on the large stump and a simple back made of two cross poles with vertical slats nailed to them was fastened between the two smaller limbs. With the bark removed and the surface coated with a dull green paint the seat harmonizes with the surroundings.

Admitting Air to a Pullman Car Without Creating a Draft

When one is traveling in a stuffy, crowded train, especially in cold weather, when all the windows are closed, the jouncing of the cars over the rails, coupled with the close atmosphere, often produced a feeling similar to sea-sickness.

Fresh air relieves this nausea, but the windows of a railway coach are so situated that when the train is moving fast, the pressure of air is so great that it rushes past the person for whom it is intended, and in cold weather causes the passengers directly behind much discomfort. To remedy this is a simple matter.

Take a newspaper, fold it once and roll it into the shape of a cone. Place the large end of the cone outside the window which is opened about 4 in. The small end is held very close to the nostrils, not at right angles to the window but at an angle, somewhat forward, at which the air can be taken in. The speed of the train causes the air that enters the large end of the cone to be carried directly to the nostrils, and as the window is only open from 3 to 4 in., very little draft is created.

If one finds that cinders are coming in through the cone, move the cone about 2 in. forward and place the hand at right angles to the face, close to the nose, on the side away from the window. In this way the air strikes the hand first and travels along the palm to the nostrils, while the cinders strike the hand and fall harmlessly to the floor.

A Test Which Tells You When Butter Is Not Butter

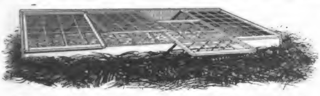
Do you know how to make a test to determine if you are buying real butter or a worked-up article such as a butter mixture or margarine? The test is an interesting one. Place a small lump of the material in an old spoon and hold this over a spirit stove or a gas burner. Watch how it boils. Real butter will boil quietly, making a large amount of froth. Margarine makes a great deal of noise, spluttering like a green

Genuine butter will always boil quietly while margarine will sputter and crackle

stick placed in the fire. This is a sure test by means of which you can find out whether or not you are really getting pure butter.

Hotbeds in Which Safely to Start Early Plants

IN the North, the most common method of starting early plants is by means of the hotbed. The hotbed consists of an inclosure covered with sash and supplied with some form of heat, usually fermenting stable manure, to keep the plants warm and in a growing condition. As a



Typical hotbed made in the earth. It is framed to hold several sash for admitting the sun's rays and keeping out the cold at night

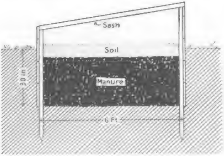
rule, the hotbed should not be placed within the garden inclosure, but near some frequently used path or building, where it can receive attention without interfering with other work. The hotbed should always face the south. The south side of a dwelling, a barn, a tight board fence, a hedge, or of anything affording a similar protection, furnishes a good location.

The Department of Agriculture instructs that in the North, the hotbed should be started in February, or early in March, in order that such plants as the tomato and early cabbage may be well grown before it is time to plant them in the open ground. There are two or three forms of hotbeds that are worthy of description. The plans suggested may be modified to suit local conditions.

Cross section of a temporary hotbed which is built entirely on the surface

A temporary hotbed, such as would ordinarily be employed on the farm, is easily constructed. Manure from the horse stable can be used as a means of furnishing the heat. Select a well-drained location, where the bed will be sheltered, shake out the manure into a broad, flat heap, and thoroughly compact it by tamping. When compacted, the manure heap should be 8 or 9 ft. wide, 18 to 24 in. deep and of any desired length, according to the number of sash to be employed. The manure for hotbed purposes should contain sufficient litter, such as leaves or straw, to prevent sogginess, and it should spring slightly when trodden upon.

After the manure has been properly tramped and leveled, the frames to support the sash are placed in position, facing toward the south. These frames are generally made to carry 4 standard hotbed sash. The front board should be from 4 to 6 in. lower than the back board so that

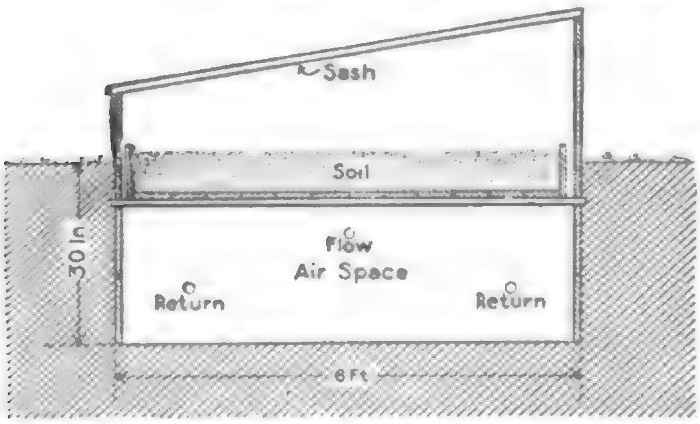


A cross section of a permanent hotbed with heating material and soil below the earth's surface and within walls made up of boards

water will drain from the glass. When the frame is in position upon the manure, the surface hotbed will appear as shown in the illustrations. The area inclosed by the glass should be covered with a good garden loam or with a specially prepared soil, to a depth of 3 to 5 in. Then the sash is put on and the bed is allowed to heat. At first, the temperature of the bed will run rather high, but no seeds should be planted until the soil temperature falls to 80 deg. F., which it will in about three days.

Hotbeds, having more or less permanence, may be so constructed that they

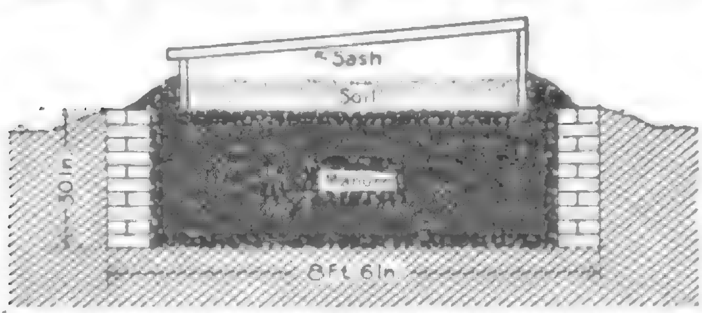
can be heated either with fermenting manure, a stove, a brick flue, or by means of radiating pipes, supplied with steam or hot water from a dwelling or other heating



Cross section of a hotbed having a lower chamber heated by steam pipes

plant. For a permanent hotbed in which fermenting manure is to supply the heat, a pit 24 to 30 in. in depth should be provided. The sides and ends of the pit may be supported by brick walls or by a lining of 2-in. plank held in place by stakes.

Standard hotbed sash are 3 ft. by 6 ft. in size, and are usually constructed of white pine or cypress. As a rule, hotbed sash can be purchased cheaper than they can be made locally, and they are on sale by seedmen and dealers in garden supplies. In the colder parts of the country, in addition to the glazed sash, either board shutters, straw mats, burlap, or old carpet will be required as a covering during cold nights. It is also desirable to have a supply of straw on hand to throw over



A cross section of a hotbed with an enlarged pit for the heating material

the bed in case of extremely cold weather.

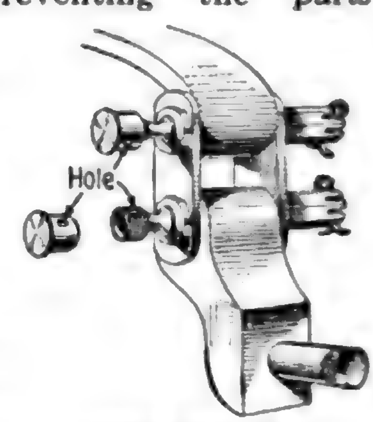
During bright days, the hotbed will heat very quickly from the sunshine on the glass and it will be necessary to ventilate it during the early morning by slightly raising the sash on the side away from the wind. Care should be taken, in ventilating, to protect the plants from a draft of cold air. Toward evening, the sash should be closed in order that the bed may become sufficiently warm before nightfall.

Hotbeds should be watered on bright days, and in the morning only. Watering in the evening or on cloudy days will have a tendency to chill the bed and to increase the danger from freezing. After watering, the bed should be well ventilated to dry the foliage of the plants and the surface of the soil, to prevent damage to the plants from damping-off fungus or mildew.

The construction of a cold frame is the same as that of temporary hotbeds, except that no manure or other heating material is provided. Cold frames are covered by means of ordinary hotbed sash, or cotton cloth may be substituted for the sash. In the North, the use of the cold frame is for hardening plants that have been started in the hotbed, preparatory to setting them in the garden. In the South, where the weather is not so severe, the cold frame is made to take the place of the hotbed in starting early plants. The same methods of handling recommended for a hotbed should apply to a cold frame. Thorough ventilation should always be maintained in any style of hotbed.

Properly Lubricating Automobile Spring Bolts

WHERE hard oil is used as a lubricant for automobile spring bolts, it sometimes dries in the small holes and grooves that feed it to the bearing surfaces, thus preventing the parts from being properly lubricated. This causes the bolts and spring eyes to wear out quickly. A way is illustrated whereby this condition may be remedied successfully by adopting oil cups for thin oil.



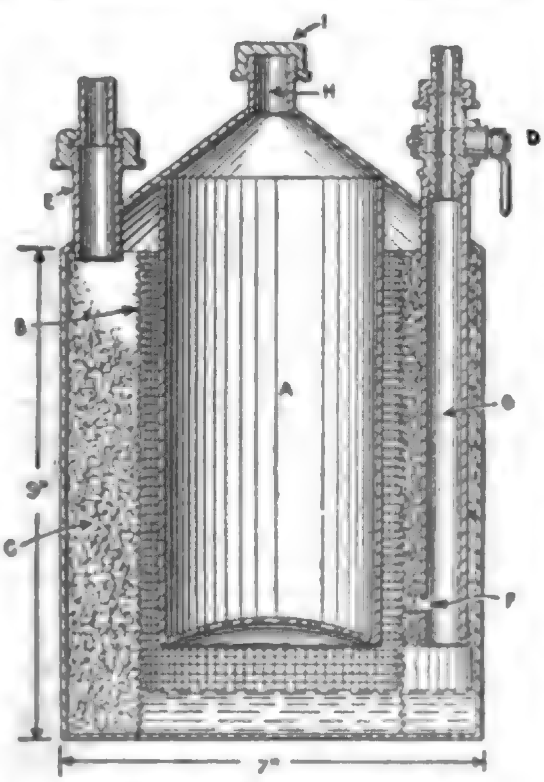
Using thin oil in hard grease cups

Drill a hole large enough to allow the oil to be poured in through the cap and threaded portion of the bolt as shown in the illustration. Then turn the cap half way around, thus completely closing the hole.—ODIS REYNOLDS.

How to Economize in the Use of Coal Gas

OWING to the increase in the consumption of coal gas both for cooking and lighting, any means of reducing the cost of it will be welcomed by the consumer. The illuminating power of gas by the use of the common tip burner is not considered so much as its heating properties. Whether it is the incandescent mantle or the gas mixed with air in the atmospheric burner of the gas stove, the effect is due to the heat produced by the combustion of the combined gas and air.

It is upon this heating effect that the intense luminousness of the mantle depends. With the use of the apparatus shown in the illustrations both the luminousness of the common burner and the heating effect may be increased considerably by mixing a volatile hydrocarbon with the gas after it leaves the meter and before it is burned. Any free carbonic oxide contained in the gas will combine with a rich hydrocarbon, carry it to the point of consumption and there develop a remarkable degree of heat and light. Moreover, the cost will be very much lower than if simple coal gas or a mixture of coal gas and what is known as water gas is employed.



An economizer for charging coal gas with hydrocarbon

When either coal gas, or a combination of coal and water gas, or water gas charged with hydrocarbon is passed through a carbureter or economizer, as described, a quantity of the hydrocarbon with which it is charged will be carried off in vapor form, thus increasing both the heating and lighting effect wherever it may be consumed. This carbureter is not at all expensive to construct, as it is mainly constructed of tin plate with a few ordinary gas fittings which any good tinsmith or plumber can make.

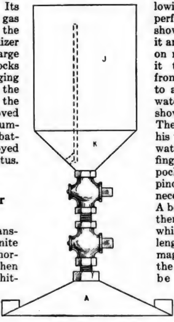
The illustration clearly shows the apparatus in section. This apparatus has been well tested. The hydrocarbon used in charging it may be benzene, benzol, benzolene or gasoline. Kerosene must not be used.

How to Make the Economizer

The outer cylinder is made of heavy tin plate while the distributing inside cylinder *A* may be made of lighter stock. A wire cylinder *B*, made of a 3/8 or 1/2-in. mesh galvanized wire netting is placed between the cylinder *A* and the outer case. The space between is packed moderately tight with dry white cotton waste, shown at *C*. The outer case is 9 in. high and 7 in. in diameter, with a cone-shaped cover attached to the upper edge. The inlet pipe *D* is provided with a stop-cock. This inlet and the outlet tube at *E* are both made of heavy tin plate, the latter being fitted with a brass gas union soldered at the top. The tubes are also soldered to the cone, while the inner cylinder *A* is fastened with solder at the point where it touches the cone. A hole is made at *F*, 1 in. above the bottom of the pipe *G*. This is to allow the gas to pass into the carbureter in case too much hydrocarbon has been introduced, which chokes the bottom of the tube and causes bubbling through the liquid, thus hindering the passage of gas. The tube *H* at the top of the cone is covered by a brass cap *I* in the interior of which is a leather disk to make a gas-tight joint.

An excellent method of filling the apparatus is to substitute two metal stop-cocks in the place of the tube *H* and another tank also made of tin plate, as here shown. By turning the two stop-cocks, the apparatus may be filled without wasting the fluid. One handle may be made to open and close the two. The tank *J* is filled with the carbonating fluid. The top of the carbureter, or economizer, is represented at *A*. A small

brass pipe, *K*, is fitted to the cone with solder. This pipe is so arranged that one end is near the hole of the stop-cock, the other end being a short distance from the top. Its function is to allow the gas to ascend, thus allowing the fluid to enter the economizer freely. As soon as the charge is completed, the stop-cocks are closed and the charging tank is unscrewed. When the operation is completed, the filling tank may be removed and used for charging a number of economizers in a battery, or it may be employed as a single piece of apparatus.
—Alfred J. Jarman.



A filling arrangement to introduce the liquid without waste

Making Diagrams for Lantern Slides

PROCURE a thin transparent sheet of zylonite or celluloid, and wash it thoroughly in distilled water. When dry, rub it with a little whiting in order to remove any grease. Drawings or writing can now be placed on the prepared plate as easily as if it were paper. Tracings made on the surface of the zylonite with India ink are superior in every way to those made on a gelatinized surface. The finished product should be clamped between two glass plates 3¼ by 4 in. The edges may be bound with paper.

A Glass of Water, Some Magic Passes, and Lo! The Water Is Wine

PUT a pinch of finely ground and sifted red sanders in a glass of water and the liquid will at once assume a red color similar to that of claret. If this liquid is poured into another glass previously rinsed with vinegar, it will assume a tint resembling that of brandy. If a little potash be added to it, it will change back into the original color and finally if a little alum be introduced it will become as black as ink. To a person not acquainted with the secret, it would appear as if claret, brandy and ink had been obtained from a glass of water.

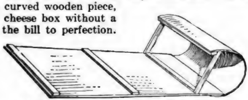
The spectators should think that only magic passes were responsible for the astonishing results. The following method is good. The performer comes forward showing a glass and passing it around for inspection. Upon receiving it back, he fills it two-thirds full of water from a pitcher. He then offers to allow anyone to taste the water, or tastes it himself to show that it is pure water. The red sanders may be in his vest pocket, and while the water is being tasted, the fingers carelessly seek the pocket and obtain a small pinch, which is all that is necessary to effect the change. A borrowed handkerchief may then be placed over the glass which is then held at arm's length in one hand while magic passes are made with the other, or the glass may be placed on a stand at the front of the stage. The handkerchief is placed over the glass for an instant and the water becomes rosy, the sanders being introduced while the handkerchief is being adjusted. The other changes are as easily effected and shown, the glass being previously dipped in the vinegar, and the alum introduced in the same way as was the red sanders.

Wine may be changed into water with equal facility and may be very nicely connected with the foregoing trick. The method is as follows: Dissolve 15 grains of permanganate of potash into 1 qt. of water. The resultant liquid will resemble claret in color. Add to this solution 45 grains of tartaric acid. Put into a bottle a few crystals of hyposulphate soda and a little water and rinse a glass with this solution. If the permanganate solution is poured into the glass it will be instantly decolorized. The tartaric acid should be introduced into the pitcher when the handkerchief is withdrawn, and the glass of course should be previously rinsed with the hyposulphate soda solution.

A Cheap Toboggan

NOTHING is more enjoyable and exciting than a toboggan slide down some steep incline. No one need forego this pleasure when a toboggan, as here described and illustrated, can be so cheaply constructed.

The essential part is the snow shield, which consists of a curved wooden piece, as shown. An old cheese box without a knot or crack fills the bill to perfection. First carefully take out the nails and pull out the top and the bottom.



A flat board strengthened with two cross pieces makes a toboggan. A curved section from a cheese box furnishes a snow shield

Next procure a good board the same width as the cheese box. It should be without cracks, and smooth on one side. Nail slats on the board, spacing them 1 ft. apart, and also fasten a strip on the end of the cheese box at the top, after the end of the box has been sawed off to the required length. Nail the other end of the box to the board, thus forming the curve or snow shield of the toboggan.

Place the side pieces connecting the top of the curved part with the board of the toboggan, thus forming handles and at the same time stiffening the shield. The top ends of the curve can be further strengthened by putting on strong leather straps.—PETER J. M. CLUTE.

The Mystery of Freezing Water Instantaneously

TO produce "ice" in the twinkling of an eye, as if by magic, is very simply and easily done.

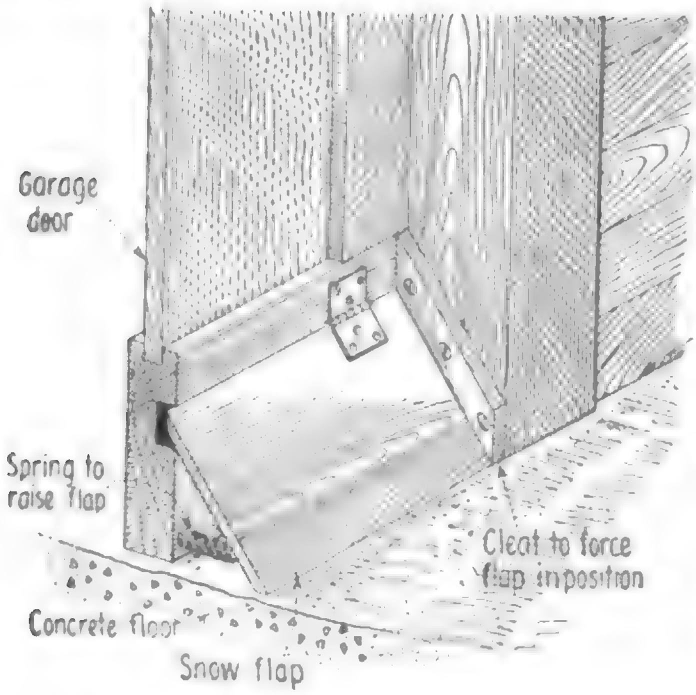
Place 50 grams, (about 2 oz.) of crystallized photographer's hypo in a small cup and add 10 cubic centimeters (100 drops) of water. Place the cup and contents on the stove, and in a few minutes the mixture will dissolve, forming a clear liquid solution. Now pour the mixture into a thin glass tumbler, the temperature of which has previously been raised by dipping it in hot water. Set the solution aside and allow it to cool, being careful not to disturb it. When cooled to room temperature, pick up the tumbler, give it a quick shake, or add a tiny crystal of the hypo, and the dissolved salt will instantly separate in a solid mass of crystals, apparently ice. At the same time, the tumbler which was previously cold, becomes decidedly warm, illustrating the scientific fact that water in freezing liberates heat.

Stop to Prevent Snow from Entering Under a Garage Door

LARGE garage doors must swing clear of the floor because there is no threshold strip at the bottom and this makes rather a large opening for snow to drift in on a windy winter's day. One owner of a private garage found that this opening caused considerable trouble as the doors faced the direction of most gales. He devised a drop, however, to work

automatically with the closing of the door. This stop is clearly shown in the illustration.

A groove was cut lengthwise of the lower rail in the door, so that the upper edge



A swinging board at the bottom of a door. It drops automatically as the door is closed

of a board or flap would enter as shown. This flap was hinged to the door and fitted with coil springs back of it to raise the board clear of the floor. A cleat was nailed to the door jamb at an angle so that when the door was closed the flap was pushed down on the floor.—HAROLD V. WALSH.

Exterminating Ground Hogs with Explosive Fumes

THERE are a good many ground hog dens in my locality. The animals are very bothersome to the farmers. I discovered a very quick, cheap and easy method of getting rid of them.

I take a pole about the size of the big end of a buggy whip and ten feet long. To the end, I tie a stick of 40% dynamite in which has been inserted a cap and two feet of fuse. I light the fuse, push the charge into the hole with the pole and then fill up the end of the hole with dirt. As it takes nearly a minute for two feet of fuse to burn down to the charge, this gives me enough time for the tamping.

The fumes of dynamite are very noxious. The explosion destroys the den and the fumes asphyxiate the animals that are in it.—CHAS. P. WALTERS.

Canvas Is Painted More Quickly When Wet

WHILE painting a heavy canvas screen, a painter was interrupted by a shower which lasted about a half hour. After the rain had stopped the work was resumed and the painter found that the wet fabric took the paint much more easily and quickly than did a dry surface. Now when he has canvas to paint, the material is first thoroughly wetted and much time is saved. If the canvas to be painted is large, he wets only about 10 or 12 square feet at a time. This is done to prevent the canvas from becoming dry again before it can be painted.—M. M. CLEMENT.

An Ingenious Carafe Used by the Eskimo

IN the north where it is almost always cold, a device for providing drinking water is made by hollowing out the top of a block of ice and putting in it a bit of moss, soaked in blubber and lighted. The moss floats on the water that soon is melted from the block. Then the Eskimo, to avoid the film of oil produced

A bit of oil-soaked moss burning on an ice cake provides the drinking water

by this floating lamp, drinks through a hollow bone, used as we use a straw. This is a new way of combining the elements of an iced drink—letting the ice hold the water.—TUDOR JENKS.

Tricks of the Trade

Attachments for Using a Vise as a Punch Press

A way to use an ordinary vise for making light duplicate parts from thin sheet metal

SMALL duplicate articles are ordinarily made in punch presses, but for the home workshop or a small jobbing shop such a press is too expensive. Ordinary punching or forming in 3/16-in. sheet metal may be handled in a vise with the power of the screw, by attaching the

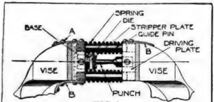


FIG. 1.
ASSEMBLY (SIDE ELEVATION)

The two parts attached to the vise jaws for holding the die and punch in line

specially constructed parts to the jaws as shown in the illustrations. With this device many small things can be turned out as rapidly and accurately as if made in a regular die press. The parts assembled are shown in Fig. 1.

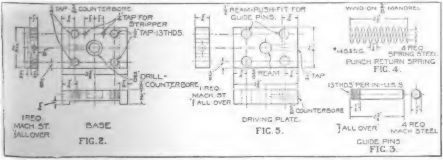
The base, Fig. 2, is attached to the fixed jaw of the vise by the upper and lower clips *A* and *B*, Fig. 1. These clips keep the base from pulling away from the vise jaw when the punch is pulled from the die. These clips are attached to the vise jaw with round head ¼-in. machine screws.

In Fig. 2 is shown four ½-in. tapped holes for guide pins, Fig. 3, two of which are plainly shown in place in Fig. 1. To assist in returning the punch after the operation, four helical springs, shown in Fig. 4, are slipped over the four pins.

The driving plate, Fig. 5, in general dimensions is a counterpart of the base. There are four holes drilled and reamed carefully to size for the ends of the guide pins. It is very necessary to make the base and drive plate accurately so that the parts will come together in line.

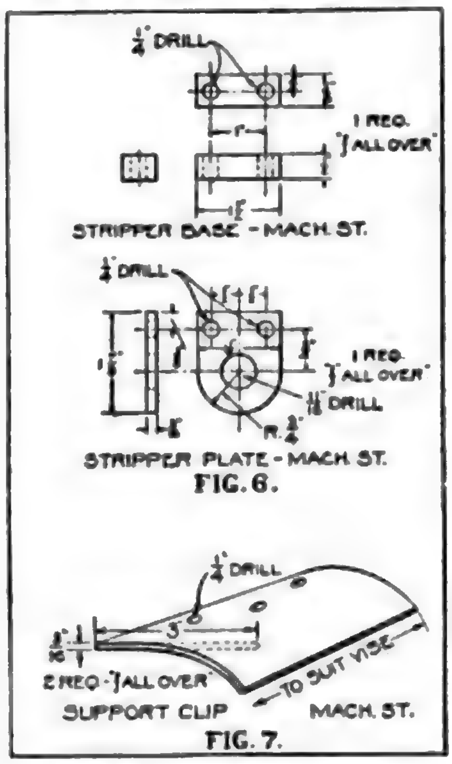
The stripper plate, Fig. 6, consists of two parts, the plate and its base block. The base block is merely a piece of metal cut to the size given, which supports the stripper far enough from the face of the die to permit the stock to be inserted for piercing.

The dimensions of the clips for holding the base and driving plate are given in the details of Fig. 5. Three punches and dies are shown in Fig. 8, 9 and 10, the simplest form being shown in Fig. 8. For ordinary punching, the punch face or end must be flat and have a clearance, as shown. Clearance is a slight taper from the cutting edge to the tank. The proper amount of this taper is 1/64 in. to each 1 in. in length. At the junction of the punch and the shank a heavy fillet should be formed as shown. Never make a punch with a square shoulder at this point.



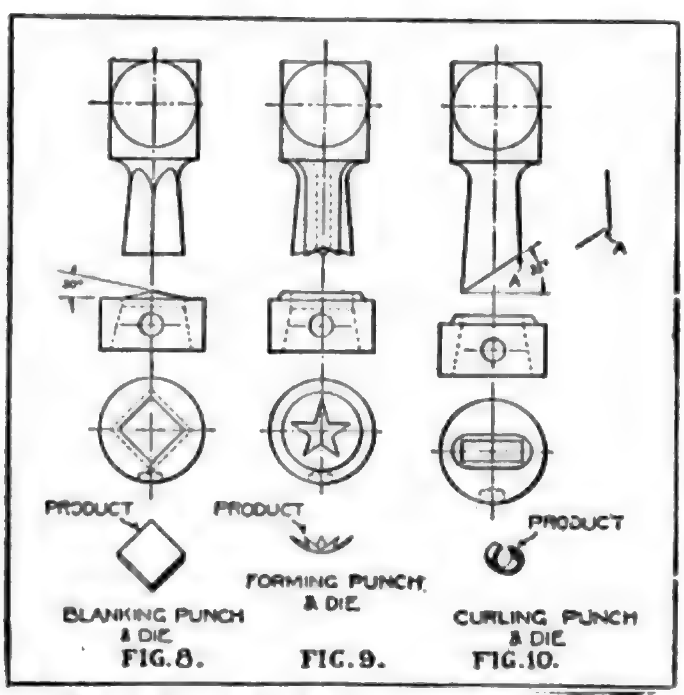
Dimensions of the various parts used in constructing the holders for the dies and the punches to attach to the jaws of an ordinary bench vise for making small duplicate parts

The die face, in this particular case, is treated differently, as it is considerably higher near the center than at the outside. This gives a shearing cut on the stock, doing the work with far less power than if the die face were perfectly flat. The die must also have clearance as shown by the dotted lines. The hole is straight for a short distance —about 1/32 in.—then it becomes larger on a constant taper, the amount of taper being the same as for the punch. This provides a clearance for the punchings and permits them to fall through easily. The shallow hole in the side of the die is for the retaining set screw shown more clearly in Fig. 1.



Details of the stripper base and plate; also jaw clips to hold the parts

The die and punch shown in Fig. 9 is for making a five pointed star in saucer shape. As this product is in the punching it must be formed in one operation. To do this the die face is made flat and the punch to shear, as shown. The amount of shear given to the punch face governs the amount of bend in the product, and, in special cases, it must be found by trial.



Three kinds of dies and punches showing their construction; also sample of work

With this punch it will be seen that the points of the star are pierced first and are forced through as the punch enters the die, the punch continuing to shear the stock and to bend it into the desired shape.

The concave to the punch face is produced by grinding. In the case of very small punches, the concave may be given by drilling before the punch is hardened, then, after the hardening, lapped with a piece of wood, oil and emery. The flutes may be chipped and filed, if there is no means of milling them with a formed cutter.

The die is marked out and drilled with a small drill so that it does not quite touch the outline or cut into the next drilled hole. To prevent the holes breaking into one another, fill the last drilled hole with a metal plug.

Another metal part in which the punching is the product is shown in Fig. 10. It is a complete ring. As in the other case, the die face is left flat and the shear to the punch face is all to one side as shown. The angle of shear determines the diameter of the finished ring. This also must be determined by trial.

If the face of the punch is made straight on an angle it will require considerable grinding throughout the cutting and will have a very short life. To obviate this wear, a short portion at the heel should be made equal to about one-half the thickness of the stock to be punched. At the terminal of the ring there will appear a straight, flat part, equal to the amount of the flat part on the punch. This can be finished by grinding or hammering.

These holding devices are not expensive to make, and where there is a good-sized vise at hand, small, round and square punches and dies may be used to advantage in punching holes in sheet metal for ordinary riveting or for tapped holes in fastening parts together with machine screws. The punches and dies for these operations are easily made.—J. B. Murphy.

Drying Shoes with Heat from an Electric Globe

A WET shoe is one of the most difficult things to dry, and if the leather is to be thoroughly dried out, the heat must be applied from the inside. A golfer designed this device for drying his golf shoes and it is useful for any shoes that are worn in all kinds of weather. Place two electric wall fixtures so that the electric globes will be in upright positions, and hook a shoe over each. Then turn on the current. An 8-candlepower lamp will give sufficient heat to dry out the leather without burning it. The light fixture should be well supported to carry its weight and the weight of the shoe.—R. G. Brown.

Drying your shoe over an ordinary incandescent bulb

Cutting Adhesive Cloth to Make Bandage Supports

ONE of the simplest and most effective bandages and supports for any surgical purpose has been devised by a prominent Philadelphia surgeon, and used successfully on a great number of his patients.

Fig. 1

Fig. 2

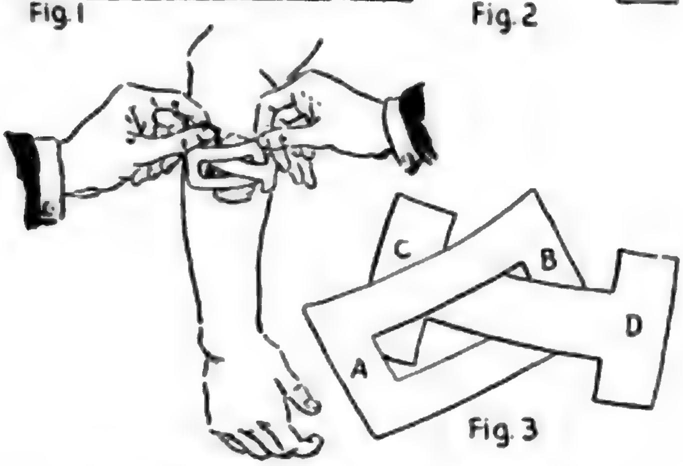


Fig. 3

Method of cutting sheet adhesive for holding bandages firmly in place on a cut

Sheet adhesive is used, and the size of the bandage is decided by the place to be covered. After the length and width are determined, the adhesive is cut into a rectangle. Then a rectangular section of the center is removed as shown in Fig. 1. A second piece of adhesive, the length and width of Fig. 1, is cut to the shape of Fig. 2. The narrow strip will then fit closely into the opening, Fig. 1.

When applying the bandage, first fasten the ends *A* and *D*, then insert Fig. 2 through opening in Fig. 1, draw together and fasten ends *B* and *C*. A firm bandage and support will thus be secured. Adhesive sufficient for a large support can be bought cheaply at any drug store.—Chas. M. Stewart.

Combination Tandem Seat and Tool Box

THE seat illustrated is built so that the person riding on it need not straddle the rear wheel.

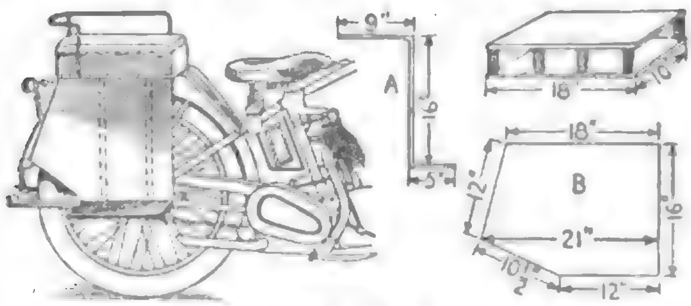
The material required for making the seat is as follows:

- 2 Pieces of hardwood 18 in. long, 10 in. wide and 1 in. thick
- 1 Piece hardwood 12 in. long, 6 in. wide and 1 in. thick
- 2 Pieces of iron bar 30 in. long, 11 in. wide and 3-16 in. thick
- 1 Piece of iron bar 12 in. long, ½ in. wide and ⅛ in. thick
- 8 Springs, 2 in. in diameter. Springs from old seats are suitable
- 32 Bolts 2 in. long
- 1 Piece of canvas
- 1 Piece of waterproof leatherette 30 in. wide and ⅔ of a yard long
- 2 Yards of gimp binding
- 5 Dozen leatherette headed nails
- 1 Piece of brass rod 3½ ft. long and ⅜ in. in diameter.

The seat frame is constructed from two pieces of 18-in. by 10-in. by 1-in. boards. Holes are first bored in the edges 1½ in. inside so that the 8 coil springs are evenly spaced and held in place with belts.

The two iron bars are bent at right angles in the shape shown at *A*. Six holes are drilled in each piece for the bolts, two in each straight length. These pieces are attached to the lower board of the seat on its upper surface so that they will hang down from one side.

A dustguard is made from the canvas piece as shown at *B*. This is cut large enough so that a seam at the edge may be made for holding the 3/8 in. rod, which is drilled, or a turn is put in at the right



Details of the parts for making a seat over the rear wheel of a motorcycle

place for fastening it to the mudguard and seat-frame. The upper edge of the canvas is tacked to the lower board of the seat. The lower edge is tacked to a small piece which is used as a footboard.

When these parts are finished, it is ready for the leatherette covering. This is fastened with tacks having leatherette-covered heads. Horsehair is packed in between the leatherette covering and the seat-board to form a cushion. The leatherette is tacked to the upper board and all surplus edges are cut away, leaving only enough for a flap over the rear opening between the boards where there is space for tools. This flap has some gimp binding sewed to its lower edge to keep the material from fraying. Two eyelets are made and buttons are attached to the wood so that the flap may be used to keep tools from falling out.

The seat is finished with a 3/8-in. brass rail, which must be bent in the shape shown and attached with screws to the edge of the upper board. A rubber foot pad attached to the footboard adds to the appearance of the seat—RAY E. STEWART.

Chemical Composition to Make Uninflammable Benzene

ONE of the most extensively used cleaning mixtures on the market has its wide sale because it is not inflammable as benzene and similar products are. It is practically nothing but a mixture of benzene and carbon tetrachloride which when mixed in certain proportions will not burn or explode when a match is applied to the mouth of the container. It was found that the best results were obtained when these two substances were mixed in the proportion of nine parts, by volume, of carbon tetrachloride to one part of benzine. This mixture does not detract from the cleansing properties of the benzene but rather adds to them.

A Leaky Tire Valve and Its Method of Repair

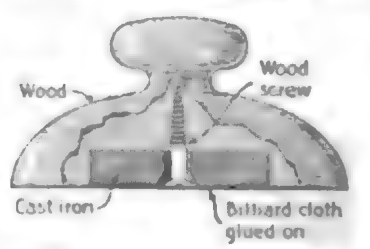
A LEAKY valve is the cause of many a flat tire, but the valve itself is not always at fault. Very often, even after a new "insert" (the inside part or valve proper) is bought and put in, the slow leak is as bad as ever. The trouble is in the rubber gasket inside the cap. This becomes displaced and swung around so that it presses on the stem and causes the air to pass out slowly. The motorist naturally screws the cap down tighter in an attempt to stop the leak which only aggravates the trouble. Straightening the cap will effectually stop the leakage.

Cements for Securely Fastening Celluloid Parts

CELLULOID scrapings dissolved in acetone make a very good cement. The resultant solution should be heated slightly to clear it up. Another satisfactory way is to moisten the two surfaces with ordinary wood alcohol and press a weight over them. Shavings of vulcanite dissolved in sulphuric ether also serve the same purpose.

Making a Substitute for Brass Paper Weights

A LARGE corporation recently made a canvass of its offices and collected all of the brass paper weights for the metal. In order to supply paper weights to take the place of those collected, one was devised that is inexpensive, ornamental and useful. The body is made of wood, which is turned in a lathe. A recess is made in the bottom, in which a piece of cast iron is held in place with a wood screw.—J. R. MINTER.



Wooden covering for a metal paper weight

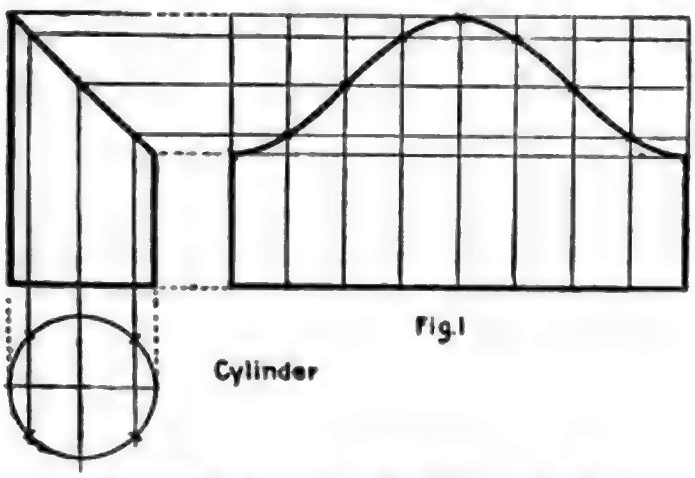
Simple Designs for Sheet Metal Working

X—Radial line development of patterns for cones and parts of cones

By Arthur F. Payne

Former Director of Vocational Education, Columbia University

MOST of the patterns developed in this series up to the present time have been for objects cylindrical in shape. The majority have been elbows and tees. These cylindrical patterns all belong to the parallel line group, that is all the lines in the drawing are parallel lines as in Fig. 1, which was demonstrated in the June, 1917, issue.

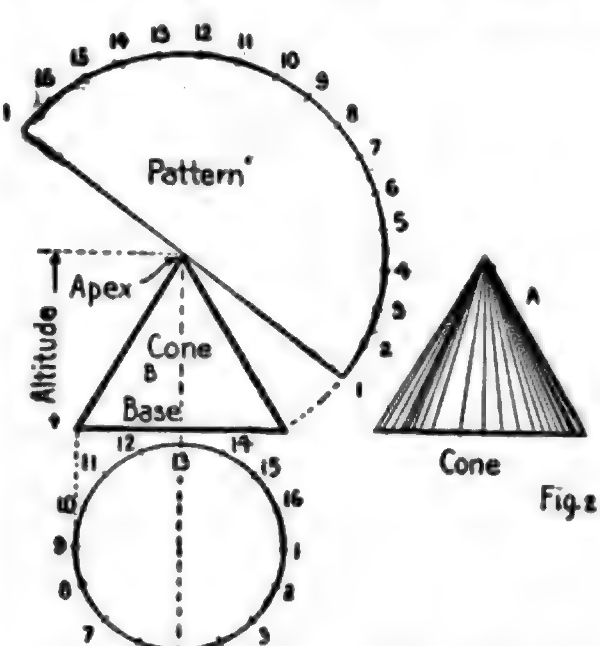


Cylindrical patterns all belong to the parallel line group. All lines parallel

In Fig. 2, we see the first problem of the group of patterns developed by means of radial lines. The patterns developed by this method are all of objects that are conical in form. In the illustration we have a perspective drawing of a cone, marked *A*, also a front view marked *B*, a bottom view marked *C*, and the pattern for the cone. The three parts of a cone, base, apex, altitude, are also indicated.

The method of developing the pattern for this simple cone is easily understood. First, draw the front view *B* the size desired. Second, draw the bottom view *C*, which is, of course a circle, the diameter of which is equal to the base of the cone. Third, divide the bottom view into sixteen equal parts. Fourth, set your pencil dividers with one point at the apex of the cone and the pencil point at the right corner of the base, then draw the arc *D-E*. Get the correct length by measuring one of the spaces on the bottom view and stepping it off sixteen times on the arc *D-E*. Draw the lines from both points numbered one and the pattern for the cone is complete. This pattern is merely the size and shape obtained by tracing the outline of a cone rolled once around on a sheet of paper.

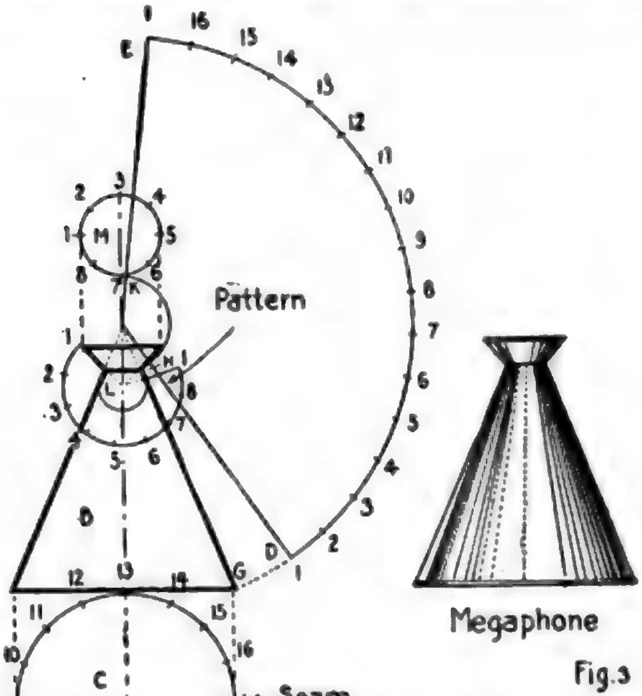
Fig. 3 shows the development of the patterns for a megaphone. It will readily be seen that this megaphone is simply two cones with their tops cut off and joined together. When the top of a cone is cut off, it is called a "truncated cone." To develop the patterns for these two "truncated cones," which make the megaphone, first, draw the front view as shown at *B*. Second, draw bottom view as shown at *C*. Third, to get the pattern of the large "truncated cone" *B*, we must first locate the "apex" of the cone, in other words, we must complete the cone. This is now done by the dotted lines meeting at *F*. Next we proceed in the same manner as we did in Fig. 2, that is, we divide the



Patterns developed by radial lines are all of objects that are conical in form

bottom view into sixteen parts, place the pencil dividers at *F-G*, draw the arc *D-E*,

find the correct length by stepping off one of the bottom view spaces sixteen times and we will have the pattern for



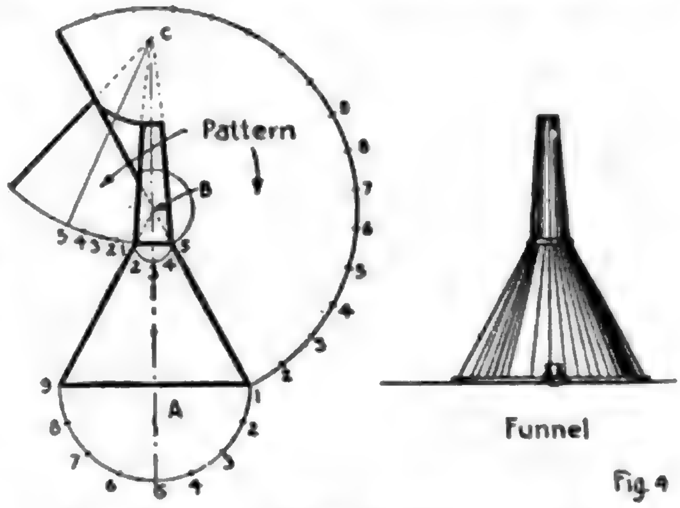
Pattern for a megaphone which consists of two cones with ends cut off

the complete cone. Fourth, to obtain the pattern line for the part that is cut off, set the pencil dividers at F and then along the line F-G at the point where the small cone is joined to the large cone, draw the arc H-K and the pattern is complete. For the small cone, the method is the same, the apex of this cone being marked L and the bottom view marked M.

In the illustration for the funnel, Fig. 4, the methods of developing the patterns are the same as for the megaphone. However the following helpful short cut has been introduced. In all of the patterns demonstrated so far, a full bottom view has been drawn. This is not always necessary and it saves time if one half the bottom view is drawn from the center of the base line, as shown at A. We know that the other half is exactly the same. When this pattern is developed, we also know that the other half of the pattern is the same. The apex of the large cone is marked B and that of the small cone C.

In the last article of this series a method of developing an approximate sphere by means of parallel lines was shown. In that sphere the sections were vertical, in the sphere shown in Fig. 5 the sections are horizontal, and the patterns are developed by means of radial lines. The method followed is exactly the same as for the megaphone and funnel. Only the half pattern is shown for segment A and B. The entire pattern is given for C. This sphere may be made of any number of segments, the greater the number of segments the rounder the sphere, and the more difficult the problem will be.

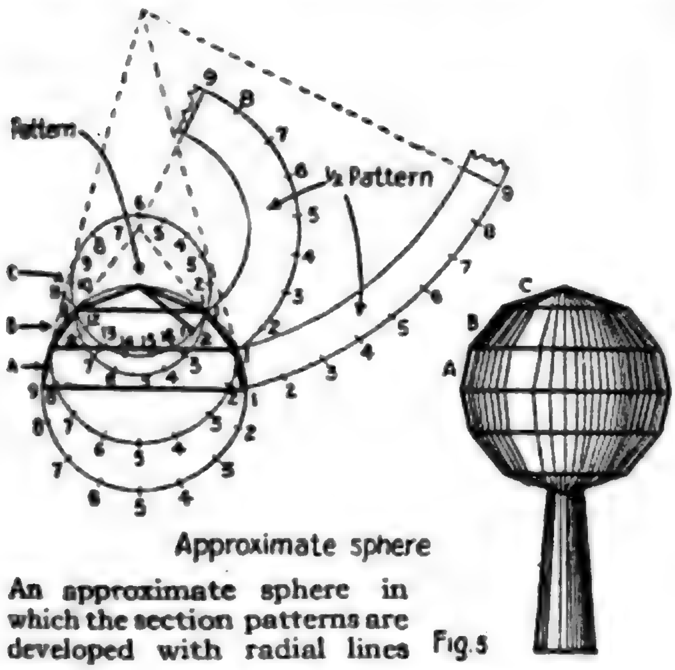
In Fig. 6, the "hopper," we have a real demonstration of development by radial lines. The other problems in this article have been given as a preparation for this one. Suppose we need a pattern for a hopper through which material is shoveled into a machine as is roughly indicated in sketch A. The first thing we must do is to see that the hopper is part of a cone. We must then draw the complete cone as is shown, getting the base, apex and altitude. Second, we must draw the full cone and lay out the part needed for the hopper as shown at B. Third, draw the bottom view C, divide into sixteen parts and draw the lines straight up until they strike the base of the cone. Then draw them converging to the apex. Fourth, draw the arc D-E with the apex as the center. Get the true length of the arc by stepping off the sixteen spaces of the bottom view. Fifth, from each of



A pattern for a funnel is the same as for a megaphone but a short method is used

these numbered points draw a line to the apex. Sixth, comes a part that is somewhat difficult to understand. It concerns the true and the apparent or false length of some of these lines. The explanation is this: if we measure the

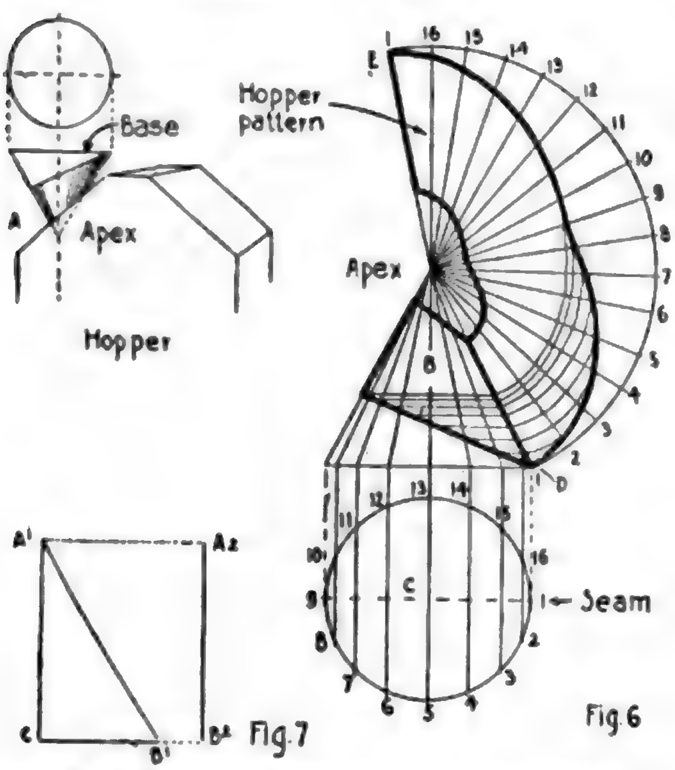
line 1 from the cone base to the apex and also measure line 13 from the cone base to the apex, we, of course, find the line 1 is the longest. In reality we know that



An approximate sphere in which the section patterns are developed with radial lines

all the lines from the base to the apex are the same length, but some *appear* shorter because if they were on a cone made of tin, they would project out towards us and would naturally appear shorter.

If we study Fig. 7 this will be more readily understood. If the line *A1-B1* is



The hopper is a good example for showing the pattern development by radial lines

one of the edges of a triangle lying flat on the paper, all three lines representing the three edges will appear in the true length, but if the triangle is turned so that the edge *A1-C1* rests on the paper, then the line *A1-B1* will be projecting from the paper towards us and the line *A1-B1* will appear shorter as in *A2-B2*. If we were speaking technically we would say the line was "foreshortened." This is the principle back of the method of developing patterns by triangulation which will be taken up soon.

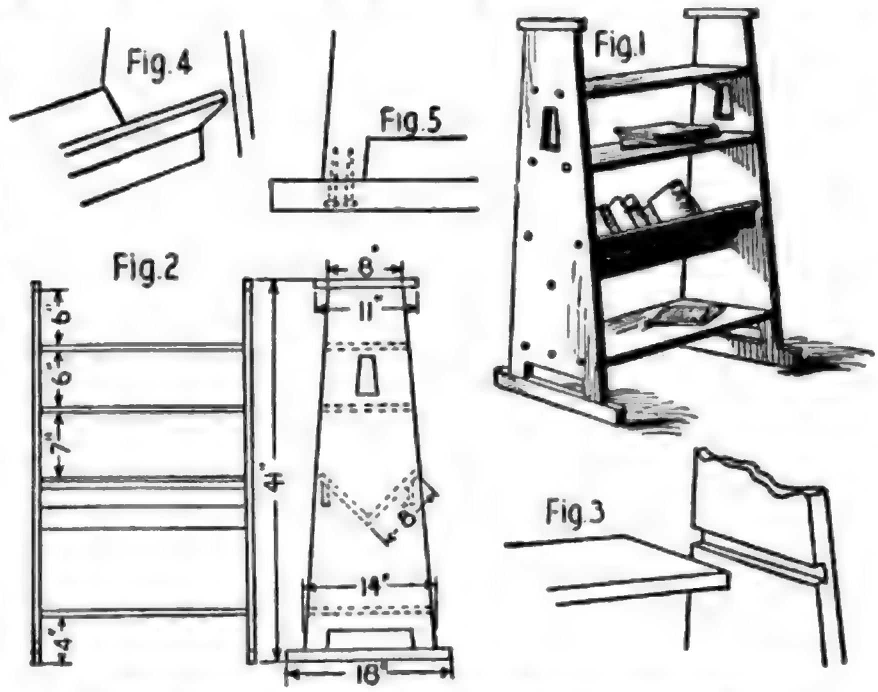
Going back to Fig. 6, we can now see that lines 1 and 9 on the outside of the cone are the only lines that are shown in their true length. To get the true lengths of the other lines on the cone for our pattern, we must draw them over to the left until they strike line 1-apex as shown in the drawing. Then with the apex as a center, swing these lines in an arc until they intersect with the same numbered lines coming up from the arc *D-E*. To explain this process in a different way to make it more easily understood, run point 1 from the bottom view upward to the base line. Next run points 16 and 2 upward to the hopper line, next over to line 1-apex, then in an arc until it strikes line 2 and 16 on the pattern, making a cross at these points. Next run lines 15 and 3 upward to the hopper line, then over to line 1-apex, then in an arc until the arc line intersects lines 3 and 15, and make a cross at the intersection. Do the same with all the other points on the bottom view, connect the crosses with a curved line and we will have the line for one side of our pattern. We must now repeat the same process for the other hopper line near the apex of the cone as is shown in the drawing, and we will have the full pattern for the hopper.

Deodorizing Benzene for Dry Cleaning Purposes

BENZENE is very useful for the removal of grease spots and various other stains. Its odor, however, is very disagreeable to the average housewife. This may be completely removed by repeatedly shaking up the benzene with a plumbate of soda solution, and rectifying it. The plumbate of soda is made by dissolving litharge in caustic soda.

A Book Shelf and Trough Made of Soft Wood

THE illustration shows the construction of a simple book shelf and trough combined. The sides are made of 1-in. yellow pine boards that taper in width from 14 in. at the bottom to 11 in. at the top. The strip at the top extends over the edges of the upright boards 1 in., and the base strip extends out 2 in. The shelves are fitted into grooves ¼ in. deep. In the place of one shelf, a trough is set in which holds the books in an upright position. The shelves are convenient for large volumes. Besides gluing all parts together, round head screws are used to strengthen the joints, and to improve the appearance. The completed book shelf can be finished with two coats of stain and one of either varnish or wax. For small jobs like this, it is best to procure finishing material in small cans from your dealer. Follow directions on the containers as different makers recommend different use of such products.—H. ALDEN.



Dimensions of the parts that enter into the construction of a simple combination book shelf and trough

Glass Cements for Commercial or Domestic Use

WHEN finely pulverized chalk is stirred into a solution of water glass at 30°B. until the resultant mixture becomes fine and plastic, a cement of extraordinary durability is obtained. It will harden in about seven hours. The cement, when mixed with a little zinc dust, will adhere to almost any surface. After burnishing, such a cement will exhibit the white and brilliant appearance of metallic zinc. A small quantity of carbonate of copper added to the chalk will produce a bright green cement. Cobalt blue wil give it a splendid blue coloration, vermilion a bright red, and carbon red will produce a violet color.

A Good Elastic Varnish for Coating Blue Prints

THE greatest drawback to the use of drawings or blue prints in machine shops and factories, is that they soil so quickly owing to handling. This obscures the dimensions of the various machine sizes, making their reading slower, and allowing possibilities for mistakes. In order to keep blue prints clean and make them last longer, one chief draftsman coats them with a flexible and waterproof varnish. This enables the drawings, or blue prints, to be wiped off with a wet cloth when they become soiled. It also allows them to be taken into damp places.

The formula for the varnish is as follows: Crush transparent and clear pieces of gum damar into small grains, then place a convenient quantity—say forty grains—in a flask. Pour on it about 6 oz. of acetone and expose the whole to a moderate temperature for about two weeks, or until the mixture has dissolved. It is necessary to shake the flask frequently.

At the end of this time, pour off the clear saturated solution of damar in acetone, and add to every four parts of the varnish, three parts of rather dense collodion, mixing the two solutions by shaking. The resulting fluid is allowed to settle and it can be preserved in well closed phials.

This varnish is applied in vertical lines by means of a soft camel's hair brush. At the first application it will appear as if the surface of the paper were covered with a thin white skin. As soon, however, as the varnish dries, it presents a clear shining surface. The varnish should be applied in three layers, or coats. It will be found by experience, that this varnish retains its gloss and remains pliable under all weather conditions.—W. S. STANDIFORD.

A Small Sewage Disposal Plant

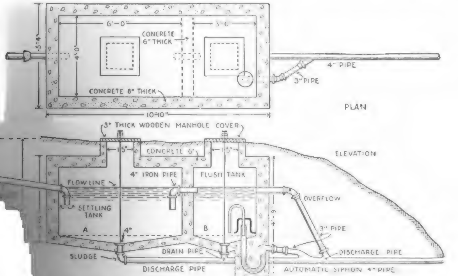
The Department of Agriculture tells in a bulletin how to construct a sewage disposal plant for the country place. This article is an extract from that bulletin

EXPERIENCE has shown that, in a small sewage disposal system, a dark, airtight tank of sufficient capacity and so constructed that sewage may remain in it entirely at rest for a period of from 18 to 24 hours, gives the best results. The solid matter settles out in such a tank and, according to the theory at present accepted, it is partially liquefied, deodorized and destroyed by countless numbers of bacteria, which thrive without air.

In such a tank a thick scum forms on the surface of the sewage, which protects the bacteria from the incoming air and is evidence of good bacterial action. The breaking up or disturbance of this scum destroys the bacterial action for the time being and is likely to cause considerable annoyance from bad odors.

The septic tank effects only about 40 per cent purification. The liquefying action in the tank, however, makes it possible to subject the sewage to a final treatment by filtration or distribution in a natural soil. This final purification is effected by means of bacteria which work in air. Therefore it is necessary that the sewage should enter the disposal system intermittently so that the system may be given a chance to air out. If the sewage enters continuously and in such quantities that the system is kept saturated, the filter or disposal area becomes waterlogged and "sewage sick" and ceases to be effective. It is therefore necessary that the final treatment system be of sufficient capacity to dispose of each dose of sewage quickly.

The septic tank for a small sewage-disposal system should ordinarily consist of two chambers. In this type of tank, the sewage is received, settled, and partially purified in one chamber, and collected and discharged from a second chamber. This type of tank, if properly designed, should operate satisfactorily. The sewage in the settling chamber suffers little disturbance, and the discharge to



The septic tank, although airtight and supposedly watertight, should be as far from the house and the well or spring, as local surroundings will permit

the final disposal system may be made intermittent by means of an automatic siphon placed in the discharge chamber.

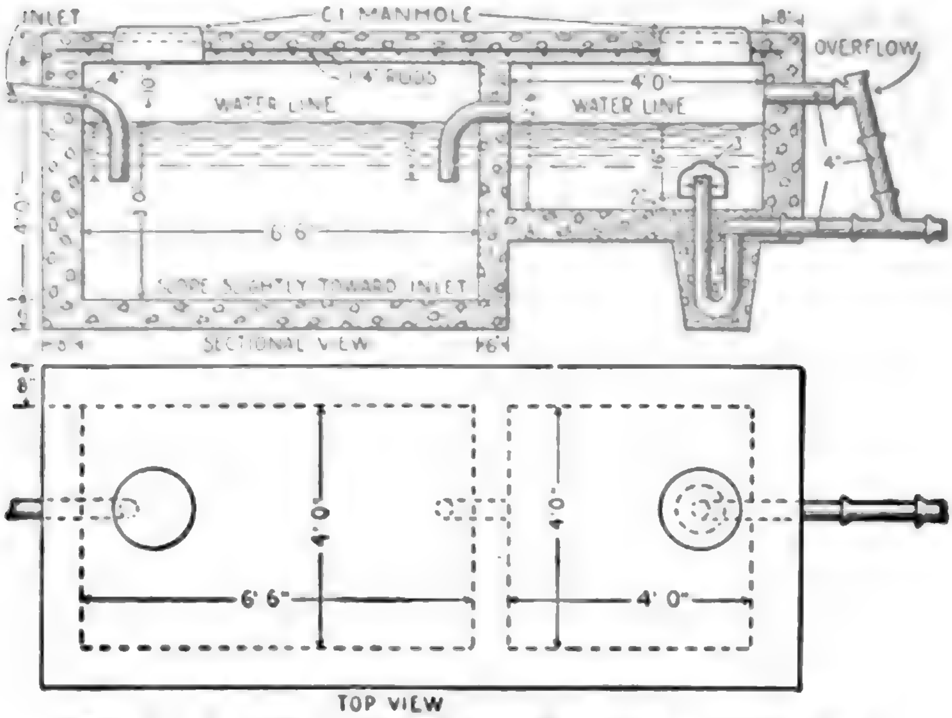


Fig. 2: A septic tank of larger dimensions suitable for a family of eight persons, and one that can be used where there is plenty of fall to carry away the liquefied matter

Experience has determined that the settling chamber of a small septic tank should have a capacity of from 5 to 15 cu. ft., or from 40 to 80 gal. per person in the family. The best results are obtained when the capacity approaches a larger limit, so that 18 to 36 hours' sewage from the house may be held at one time, to undergo sedimentation and bacterial action for this length of time. Care should be taken not to make the tank so large that liquefied sewage remains in it more than 36 hours, lest putrefaction set in.

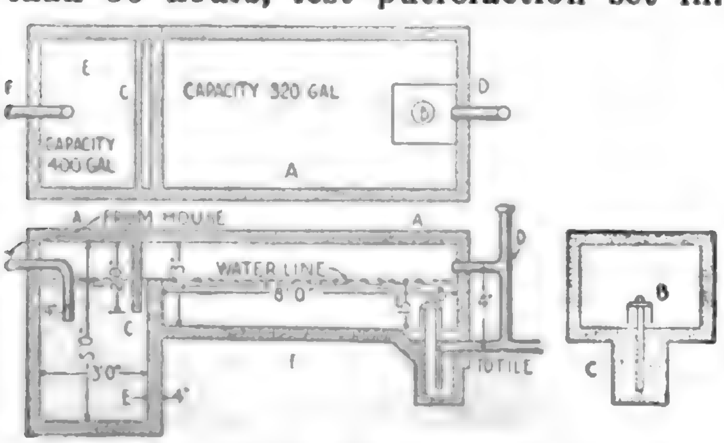


Fig. 3: A double chamber septic tank for use of six or more persons. It is practical where the outlet fall is difficult to obtain

For this reason one should make an accurate estimate of the daily sewage flow, which will be practically equal to the daily water consumption. Although a depth of 3 ft. may be sufficient for some classes of sewage, it is better to have the depth from 4 to 8 ft., according to the number of people, in order to give the sludge a good chance to settle and liquefy. The width of the chamber may ordinarily be about one-third or one-half the length, although this may vary for economy and convenience. The width should not be less than 3 ft., however.

The inlet from the house should be provided with an elbow, so that the discharge will be at least a foot below the contained sewage, thus preventing disturbance of the surface scum. The outlet from the settling chamber should be equipped in the same way. Where the entrance and discharge velocities are very strong, baffle walls of wood or concrete should be placed before these openings to break the current. These precautions are especially beneficial in the smaller sized tanks.

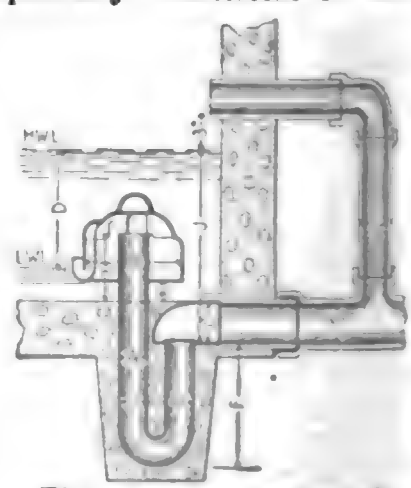


Fig. 4: An automatic siphon that may be set to operate at certain intervals

The discharge chamber should be of such capacity and depth as to discharge about every 10 or 12 hours. It may be desirable to discharge at more or less frequent intervals according to the nature of the soil in the disposal area. This action may be controlled by the arrangement of the discharge chamber and the siphon. Where little outlet fall is available it is possible so to construct the discharge chamber that its floor will be considerably above that of the settling chamber.

The capacity and depth of discharge chamber and the size of siphon will depend on the number of persons served and the means of disposal. If a sand filter or a distribution system in

heavy loam soil is used, the discharge chamber must be larger and deeper, in order that the discharge interval may be lengthened and the distribution system be given ample time to aerate. If the distribution is in sandy or very porous soil the discharge may be more frequent.

The table of dimensions of septic tanks suggests sizes of settling and discharge chambers and the corresponding siphon sizes to apply to various average conditions. The depths of siphon chambers given are the minimum allowable.

The table is computed on the basis that the inlet and outlet of the settling chamber should be placed with their inverts 12 in. below the roof of the tank, thus making the depth of sewage in both settling and discharge chamber 12 in. less than the mean inside depth.

The tank dimensions given are for average cases only and are not standard for all such cases. They are subject to variations to suit local conditions; yet care should be taken not to vary any of the essential dimensions, and not to go below the given minimum depth of the siphon chamber.

In the illustration Fig. 1, is shown a double-chamber septic tank for a family of six people. Another type of tank for a family of eight people is shown in Fig. 2. These tanks are suited to conditions where plenty of outlet fall is available. A double-chamber tank for a family of six persons is shown in Fig. 3. This tank is suited to flat ground where outlet fall is difficult to obtain, as will be noted by the difference in elevation between the floors of the two chambers. For satisfactory operation, a small septic tank should be a size suitable for use by at least six persons.

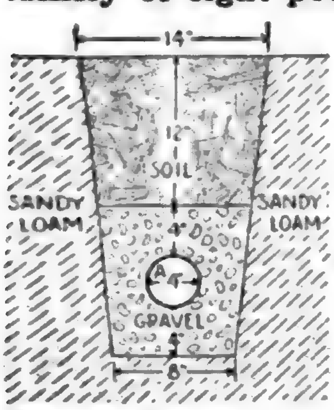
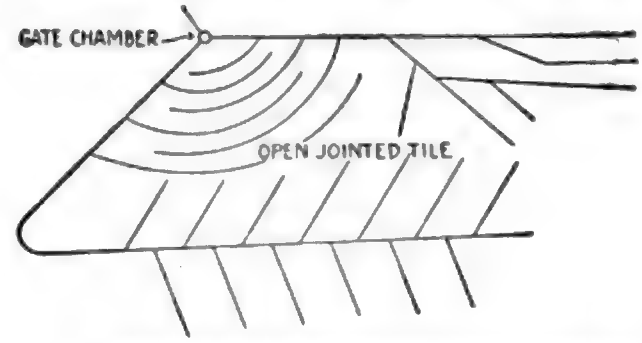


Fig. 6: Cross section of a single tile sewage disposal system

The septic tank, although airtight and supposedly watertight, should be located as far from the house and the well or spring as convenience and local surroundings will permit, thus reducing the danger of pollution or nuisance in case of leakage or improper operation of the system.

The sewer from the house should be of vitrified sewer pipe, usually 4 in. in size, with tightly cemented joints, and should



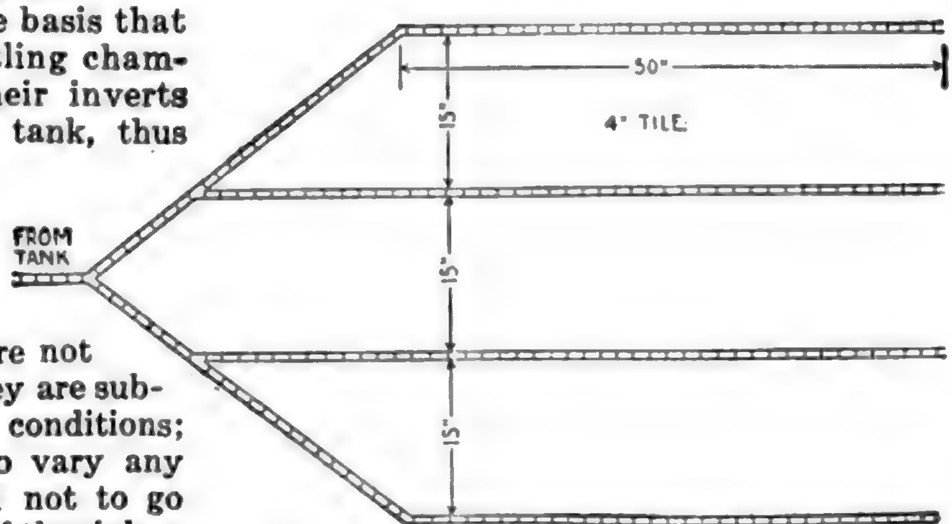


Fig. 5: A ground plan for the laying of the tile in a system leading from a sewage disposal plant to drain the tanks underground

be laid to a grade of less than 9 in. per 100 ft. Where the fall from the house to the tank is excessive, it is a good plan to lay at least 100 ft. of tile to the minimum grade to break up entrance velocity.

It is assumed that the farmer has a working knowledge of small concrete structures. The septic tank, preferably of concrete, should be made as nearly watertight as possible. The walls should be 6 or 8 in. thick, the floor 4 to 6 in. thick, and the roof about 6 in. thick and reinforced. Some means should be provided at the bottom to facilitate the cleaning out of the settled sludge. Either the floor may be sloped toward

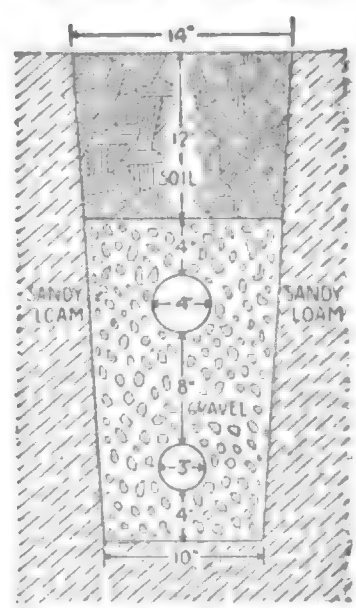


Fig. 7: A single tile system with underdrainage tile

the inlet-end for this purpose or a pipe with a valve may be installed below the tank, as shown in Fig. 1 and 2. The discharge chamber should be fitted with an outlet, set above the siphon, which will allow the sewage to escape in case the siphon becomes clogged.

A concrete mixture of 1 part cement to 2 or 2½ parts sand and 4 or 5 parts of broken stone or gravel should be used in the construction of the tank, It is an excellent idea to waterproof the concrete.

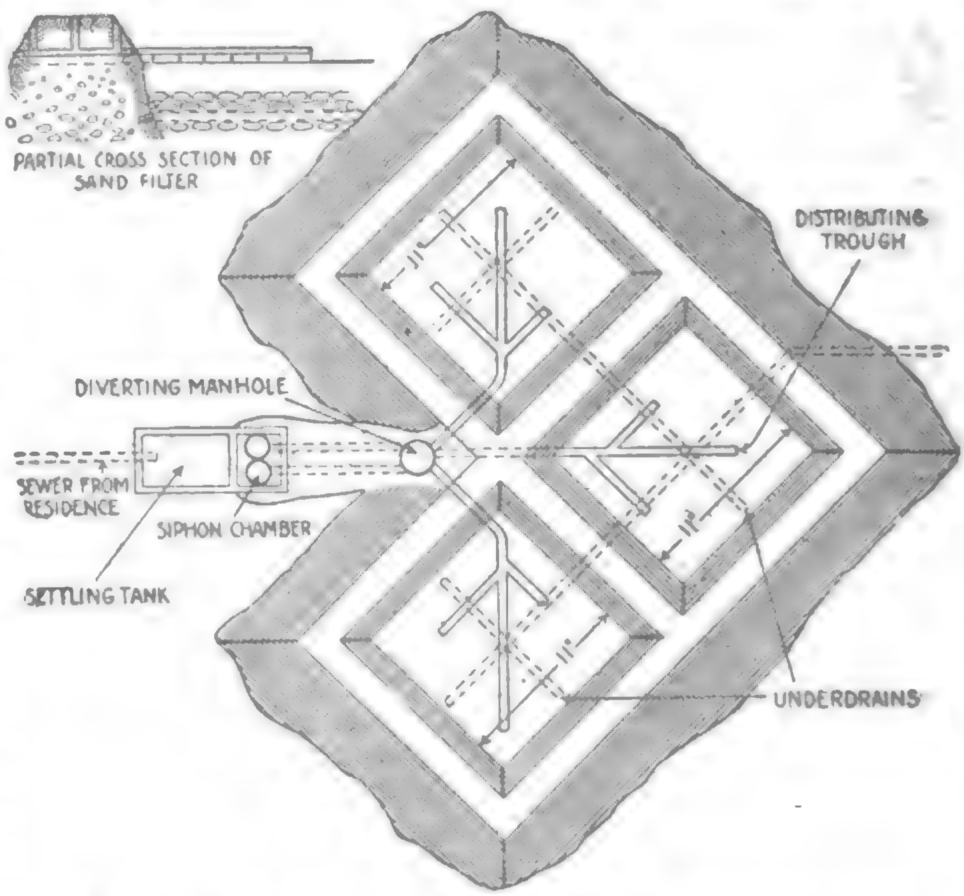


Fig. 8: A sand filter on a level area with embankments about two feet high that inclose the beds, in which one cubic yard of filtering material is used to each fifty gallons of sewage flow

An automatic siphon is shown in Fig. 4. It operates as follows: As the liquid enters the discharge chamber its weight increases with increasing depth, and the air between the water surface in the bell and the water in the siphon-leg is compressed. As the water outside increases in depth, the compression inside becomes greater until the water outside reaches the drawing or discharge depth for the siphon. Then the inside pressure is sufficient to force the water in the siphon-leg around the bend, instantly relieving the compression. The water from the tank then rushes in to fill up the space which was occupied by the air and starts the siphon, which continues until the outside and inside pressure are again equalized.

Where the soil is porous or sandy and there is plenty of area available, which is used for no other purpose, the sewage from the septic tank may be discharged through 4-in. distribution tile laid on the surface of the ground in gridiron or herringbone fashion. The area necessary is from 450 to 500 sq. ft. for each person served, if the soil is very porous or sandy, and the soil should be either tile-drained or have natural underdrainage.

A better method of disposal is by subsurface distribution. In this method the tiles are placed in the ground in herringbone or gridiron fashion, not deeper than 14 or 16 in. from the surface of the soil to the top of the tile. Ground plans for such systems are shown in Fig. 5. In very porous or sandy soils 1 ft. of 4-in. tile per gallon of discharge for each day is sufficient. In the heavier loam soils 2 ft. or sometimes more of 4-in. tile for every gallon necessary. A rough estimate should be made of the number of gallons of sewage in each discharge from the tank and the number of discharges per day. Not less than 35 ft. of 4-in. tile per person should be used in sandy or porous soil and not less than 60 ft. per person in very heavy loams. In average loams 300 to 400 ft. of tile are sufficient for a family of six or eight persons.

Aeration of heavy soils can be effected by the use of coarse cinders or gravel laid in 12-in. to 16-in. layers in the bottom of the tile ditch with the top about 12 in. below the surface. The tiles are laid in these at the usual depth. Such an arrangement is shown in Fig. 6. The disposal tile should have a fall which does not exceed 1 in. in 50 ft., or the water will rush to the lower end and water-log the soil. The tiles are usually laid about ¼ in. apart and in rows about 15 ft. apart. The latter distance, however, will vary with the porosity of the soil. Where there is no subsurface drainage, artificial drainage

should be provided by means of tile drains laid below the sewage tile as shown in Fig. 7. In some cases an impervious stratum underlying the filter earth is underlain by a stratum of sand. Cases have been noted in which this impervious stratum has been broken by dynamite at 15 to 20-ft. intervals along the tile line, to provide natural drainage.

If surface disposal is not feasible, as when the soil is compact and nearly impervious, or is swampy making underdrainage hard to arrange, disposal by intermittent flow and filtration is necessary.

The sand filter usually is a bed of sand 3 to 4 ft. thick, which is fine on top and gradually increases in size to coarse gravel at the bottom. The sewage from the tank is distributed over the filter by means of tile laid loose-jointed over the surface in much the same manner as in the ground surface distribution system. The filter should be sufficiently porous and there should be sufficient natural or artificial underdrainage to allow every dose of sewage to sink away rapidly. Sewage should not stand on the surface of the filter for any length of time, as this soon destroys its purifying properties. About 45 sq. ft. of filter should be provided for each person served by the sewer. The area should be divided into from three to five beds so that each bed may be allowed to rest occasionally. A plan and a partial section of a sand filter for a family of eight persons is shown in Fig. 8.

Number persons.	Settling chamber.			Siphon Chamber.						Siphon diameter.
				Sand filter or heavy loam distribution.			Sandy or porous soil distribution.			
	Width inside.	Length inside.	Depth.	Width inside.	Length inside.	Minimum depth.	Width inside.	Length inside.	Minimum depth.	
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Ft. in.*	*Feet.*	*Feet*	*Ft. in.*	*Inches.*
6	4	6	3½	4	3	2 4	3	2	2 4	3
8	4	6½	4	4	4	2 4	3	2½	2 4	3
12	4	7	5	4	5	2 5	3	4	2 5	4
15	4	8	5	4	6	2 5	3	4	2 5	4
25	4	10	5	4	6½	3 2	3½	4	3 2	5
35	4½	12	5	4	6¾	3 2	3¾	4½	3 2	5

The above table is computed on the basis that the inlet and outlet of the settling chamber are placed with inverts twelve inches below the roof, making the sewage depth twelve inches less than the inside depth

In constructing a filter, a sufficient area should be leveled off and small earth embankments be made 18 in. to 2 ft. high to inclose the beds. The depth of the filtering material will depend largely on the porosity of the subsurface and the means of underdrainage, but it is well to have it not less than 2½ ft.; 3 to 5 ft. is better, but the depth should not exceed 6 ft. A good plan is to allow a minimum of a cu. yd. of filtering material for every 50 gal. of sewage flow.

Lighting an Alcohol Lamp with a Glass Rod

PLACE a quarter of a teaspoonful of permanganate of potash crystals in the bottom of a glass tumbler, moistening them with a few drops of water. Then, just barely cover the mixture with concentrated sulphuric acid—oil of vitriol. A very vigorous action will at once begin, and a glass rod dipped in the mixture, then touched to the wick of an alcohol lamp will immediately create a flame. The chemical action in the tumbler produces ozone, a concentrated form of oxygen, and the rapid oxidation of the alcohol in the wick brings it to its kindling temperature and lights the lamp.

A little ether poured on a glass plate can can also be ignited by simply touching it with the glass rod after the rod has been dipped in the tumbler. This experiment may be used to advantage by the house magician to fill out the program of an evening's entertainment.

To Prevent Mildew in a Damp Clothes Closet

THE careful housekeeper is often greatly troubled and perplexed by rust and mildew formations caused by damp closets. This state of affairs can be easily remedied if an earthenware bowl or a deep plate full of quicklime be placed in the closet. The lime absorbs the moisture, sweetening and disinfecting the damp corners. Rodents and insects that are likely to congregate in such places greatly dislike the odor of the lime. When the lime becomes slaked it should be thrown away and a fresh supply substituted.

Cleaning a Bowling Ball Quickly Without Injuring Its Surface

IT often requires much time and patience to keep the surfaces of bowling balls clean and round and smooth. One alley manager found this cleaning expense amounted to a considerable sum, so to reduce the time cost he devised the cleaning stand shown. It is not necessary to have such an elaborate stand as the one pictured, since the only requirement is a concave or semi-spherical depression turned in the end of a post or of a piece of wood, which is large enough to hold the balls securely and with a little larger circumference than that of the balls to be cleaned. Into the depression place a pad of steel wool of sufficient fineness to clean the balls without marring the surface. A ball placed in this and given a whirl or a few turns, will be quickly cleaned. Afterwards it should be rubbed with an old towel.

Place the steel wool in the cup, then turn the ball on it until the surface is clean

Almost every alley will have an old post used to set a ball in for the players. Such a post is just the thing, but if it is not available, one can be turned for the purpose. In turning a post be sure that the concave correctly fits the surface of the ball.—S. E. BURKETT.

A Primer for Carrying in a Motorcycle Tool Box

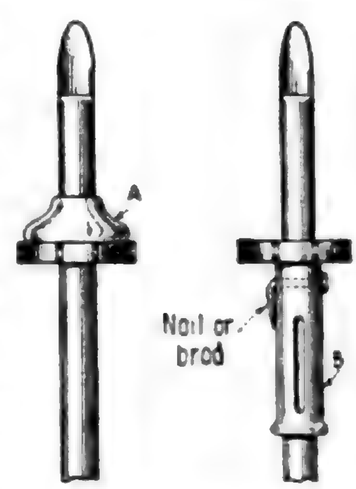
PRIMING devices are not always at hand for the motorcyclist, and on a cold morning trouble follows if a rich mixture cannot be drawn into the cylinder. While my method may be a very crude one, it has helped me in many instances. I procured a small vial or bottle of sufficient size for one charge. This, I used to catch the gasoline from the drip cock and to transfer it to the cylinder through a spark-plug hole. I keep the glass vial in a piece of pipe which is carefully corked on both ends to prevent possible breakage—LE CONTE TALLEY.

How to Make a Flashlight of Dazzling Brilliancy

AN excellent flash powder which produces a light of dazzling brilliancy, may be made by mixing equal quantities of magnesium dust and powdered chlorate of potash. Place the mixture on a piece of asbestos paper, and ignite it with a long wax taper. In a darkened room the suddenness and extreme brilliancy of the flash will dazzle everyone and produce a startling effect.

Supplying a Rib-Holding Piece to an Umbrella

AN umbrella-mender being without the proper fitting to replace the upper rib-holding portion, marked *A* in the illustration, searched through his kit until he found a lower section, *B*, that would fit the shank. As the portion of the shank under the upper rib-holding piece was rusty and somewhat thin, with a punch he easily drove a hole through it and the fitting at the same time. A nail was inserted and clinched. When the ribs were assembled the umbrella worked as well as usual.—JAMES M. KANE.

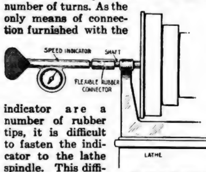


Changing umbrella parts to make necessary repairs

The Amateur Electrician And Wireless Operator

A Speed Indicator Will Count the Turns for Your Coil

IN winding coils on a small lathe, a speed indicator may be used to count the number of turns. As the only means of connection furnished with the indicator are a number of rubber tips, it is difficult to fasten the indicator to the lathe spindle. This difficulty may be overcome by using a rubber tube as shown in the illustration. If the lathe spindle is too large, whittle a wooden plug with a peg on the end to fit in the hole.—EDWARD MCCLURE.



Speed indicator on a small lathe spindle

The Electro-Deposition of Copper on Insects and Flowers

MANY interesting specimens can be permanently preserved by the following process, which is both inexpensive and simple.

Melt together 110-115 grams each, of wax and deer's fat, and add 10 grams of phosphorus dissolved in a solution of 150 grams of carbon disulphide. Be careful to keep the phosphorus and carbon disulphide solution away from the flame, for the mixture is explosive. When it has nearly cooled, stir it thoroughly and then pour it carefully through a glass tube, or preferably a funnel, under the surface of the substance. The articles to be plated are attached to a wire and dipped in the mixture. Then they are given a bath in a solution of dilute nitrate of silver. When the silver turns black, the articles should be rinsed in water, and immersed in a weak chloride of gold solution, after which they are again washed. Now that they are coated with a film of gold, the articles are ready for the coppering solution.—HERMAN NEUHAUS.

An Electric Bell Signal to Indicate Falling Snow

WITH many square feet of sidewalk to keep free from snow, I have found the device illustrated, helpful to warn me of any unexpected snowfall during the night.

Between two upright boards, about 12 in. high by 6 in. wide, I suspended a piece of silk, connecting each end with

Silk cloth between supports to catch snow for making indoor electric connections

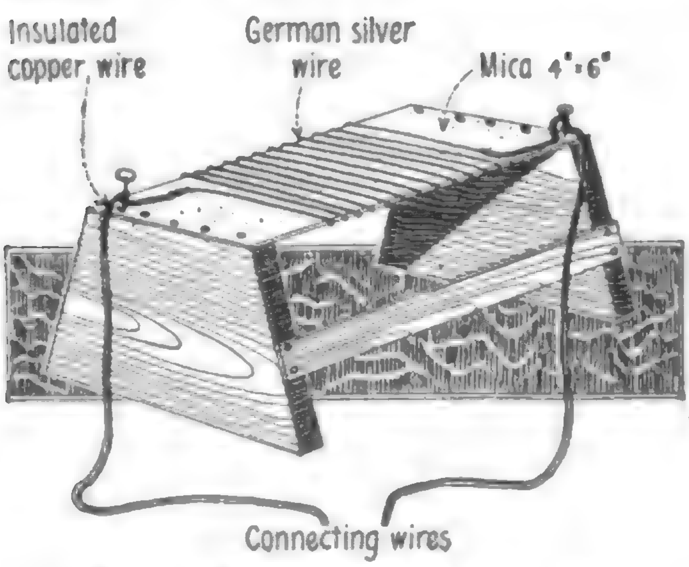
a bell and battery in my bedroom. The silk is a non-conductor when dry, but when snow falls and wets it, the circuit is completed and the bell rings. To facilitate the melting of the snow the silk should be well sprinkled with common table salt.—F. E. BRIMMER.

Making Silver Contact Points for a Spark Coil

A GOOD way to make contact points for almost any kind of instrument is explained as follows: Procure a piece of carbon, such as is used in dry batteries, and drill a hole in the center of it the size desired for the contact. This hole is then filled with small strips of silver, procurable at a jeweler's shop. After the hole is filled with the loose silver, the carbon is placed in a fire and heated until the strips are all melted into one piece. Then the carbon is cooled and broken away, leaving a rod of silver, the right size for the contact. Such contacts 5/32 in. in diameter have been in use on a 2-in. spark coil for some time and they give satisfactory results.—ODIS REYNOLDS.

Electric Toaster to Operate on Dry Batteries

THIS home-made toaster can be used where no electric light current from a power house is obtainable, by employing either dry or wet batteries. Take a piece



Heating element wound on mica for an electric stove to be run on battery current

of mica—isinglass from an old coal stove—and upon it wind about twelve turns of German silver wire. A good size for the mica plate will be 4 by 6 in.

To support the mica with its wire coil, cut out of ¼-in. hardwood, two pieces of the shape shown in the drawing, 8 in. wide at the base and 6 in. wide at the top. A height of about 3 in. will be right. These two pieces should be held 6 in. apart by means of two strips 6 in. long by 1 in. wide nailed on the ends. On the top, the mica is fastened with small tacks.

Drive medium sized nails into the wood at opposite corners of the mica plate, driving each only half way in. These will be convenient for holding the connecting wire. This should be insulated copper wire and should be connected with the German silver wire and to the batteries at either end.

When the current from two or more dry cells is turned on, the current will flow from the batteries, through the positive copper wire, through the German silver wire, back through the negative copper wire to the battery. The German silver wire has so much resistance that it will become red hot as the current passes. A slice of bread laid on the red hot wires will toast quickly. A trial test with the number of cells to be used will determine the size and length of wire that you will need.—F. E. BRIMMER.

German Wireless Plotting Muffled by Band Music

A GERMAN cruiser interned at Honolulu, relayed wireless messages from German agents in the United States to Japan, with the intention of embroiling the two countries in war. The wireless apparatus was worked while the ship's band played vigorously.

It appears that the former German Ambassador and his principal aids figured in the plot. The former German Consuls at Honolulu and Manila were also implicated. Both of these men pleaded guilty recently of participation in a plot to establish a revolutionary government in India.

A German secret agent, who was known by a number similar to a submarine, aided in the transmission of these messages, and advised the German government of the sailing time of vessels. The captain's diary reveals these secrets. After its discovery the captain was court-martialed and is now in solitary confinement pending his removal to Fort Douglas, Utah.

In February, 1917, the Cruiser Geier was set afire by her crew and badly damaged. The vessel was towed to the Pacific Coast for repairs.

Electrical Devices and How They Work

Principles of Electromagnets—III.

It is the flow of current through a conductor wound about a soft iron wire, that makes an electromagnet

By Peter J. M. Clute, B. E.

IT is evident that an electric current and a magnet exert a mutual force on each other. Since a magnetic field is a region in which a magnetic needle is acted upon by a force tending to turn it in some direction, it follows that the space surrounding a conductor, when an electric current is flowing through it, is a magnetic field.

Knowing from experiments the direction of current in the conductor, the following rule is deduced for the direction of the lines of force around the wire:

If you grasp the conductor with the right hand, with the extended thumb pointing in the direction of the current, the lines of force will be around the conductor in the direction of the fingers, as shown in Fig. 1.

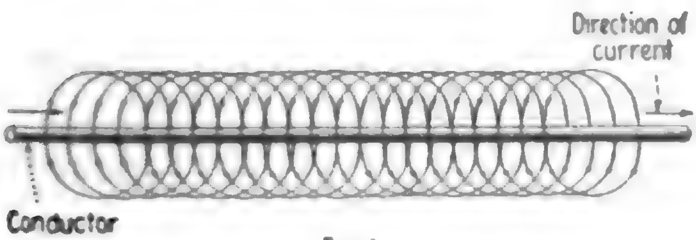


Fig. 1

The lines of force will be around the conductor in the direction shown by the coil

The direction of the lines of force around a conductor is more clearly shown by the arrows in Fig. 2, where it is assumed that the current in the wire is flowing toward the observer. Reversing the direction of the current causes the lines of force around the conductor to be reversed.

If a current-carrying conductor is bent in the form of a loop, as in Fig. 3, all the lines of force surrounding the conductor pass through the loop in the same direction. Any magnetic substance placed in front of the loop tends to place itself with its longest axis projecting into the loop, in the direction of the magnetic force.

By forming a helix of the conductor, the lines of force around and inside each loop will be similar, forming an equivalent of long lines of force threading through the entire helix.

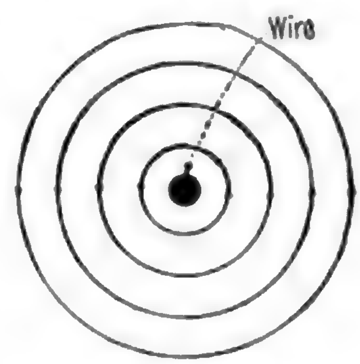


Fig. 2

The direction of the lines of force are shown by arrows

The appearance of the magnetic field around a helix through which a current is flowing, is illustrated below in Fig. 4.

A helix containing a number of turns through which current flows is called a solenoid. The polarity of a solenoid, or the direction of the lines of force through it, depends on the direction of the current in the conductor.

The polarity of a solenoid may be determined by the following rule: Looking at the end of the helix, if the current flows around it clockwise, that end will be a south pole; if in the other direction, it will be a north pole.

When a magnetic substance, such as iron, is placed in a magnetic field, so that the magnetic lines of force can reach it, the substance immediately becomes magnetic. The lines of force appear to crowd together and tend to pass through the

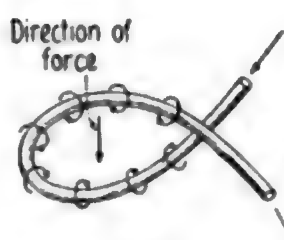


Fig. 3

Fig 4

Showing the direction of the lines of force in a loop or through a helix through which a current of electricity is flowing

substance. While under the influence of the magnetic field, it behaves like a magnet, and has polarity, the same as for a solenoid. A magnet, so produced, is termed an electromagnet; and the magnetic substance (soft iron), around which the current circulates, is called the core—see Fig. 5. The magnetizing coil usually consists of a large number of turns of insulated wire.

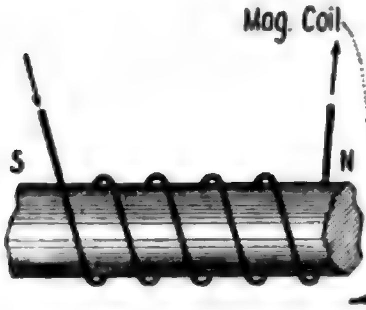


Fig. 5

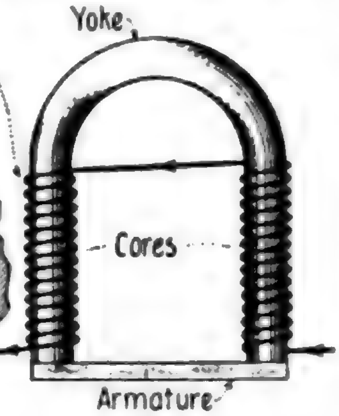


Fig. 6

An iron bar encircled by a current is a core, and in a U-shape forms an electromagnet

Electromagnets differ from permanent magnets in several particulars: 1. They are made of soft iron instead of steel; 2. The magnetizing force is an electric current, and not another magnet; 3. The magnetic properties exist only while current flows in the magnetizing coil; 4. The magnetic strength is variable, approximately proportional to the current flowing; 5. The polarity changes with change in the direction of the current, and hence can be instantly reversed.

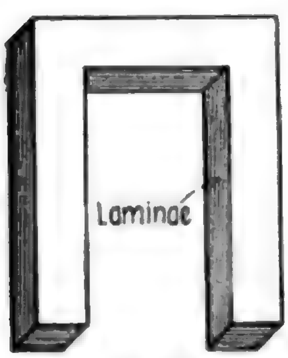


Fig 7

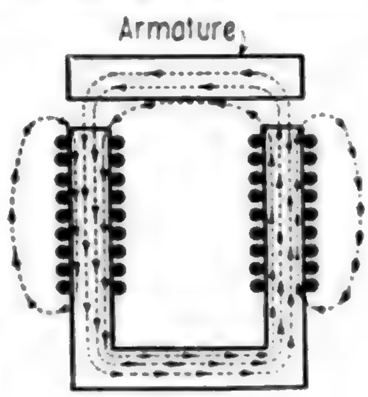


Fig 8

A laminated core for an alternating current and the coils surrounding a core with lines of force about a magnetic circuit

A typical form of electromagnet is illustrated in Fig. 6. On each of the legs of a horseshoe-shaped core is wound a cylindrical coil of insulated wire. The coils are so connected that current flows in opposite directions around the two legs of the magnet, making one end a north pole, and the other a south pole. When the soft iron armature is placed across the two poles, a closed iron circuit is obtained, and if the armature is large enough, most of the magnetic induction will be in the iron, since the lines of force will be closed curves. The number of lines of force produced in the core of an electromagnet may be considered as due to the relation of two factors, the magnetizing power of the current in the magnet coils, called the magnetomotive force, and the resistance to magnetization offered by the iron core, its reluctance, or

$$\text{Magnetic flux} = \frac{\text{Magnetomotive force}}{\text{Reluctance of core.}}$$

The magnetomotive force is produced by current circulating in the coil and so far as magnetism is concerned it does not matter whether 100 amperes of current flow once around the bar or whether one ampere circulates 100 times. The magnetizing force is always proportional to the product of number of turns and the current flowing in the coil. This product is known as ampere turns.

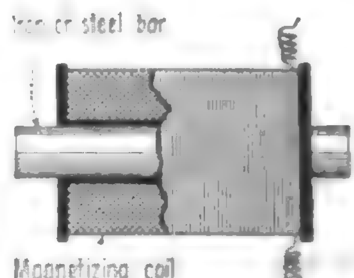


Fig 9

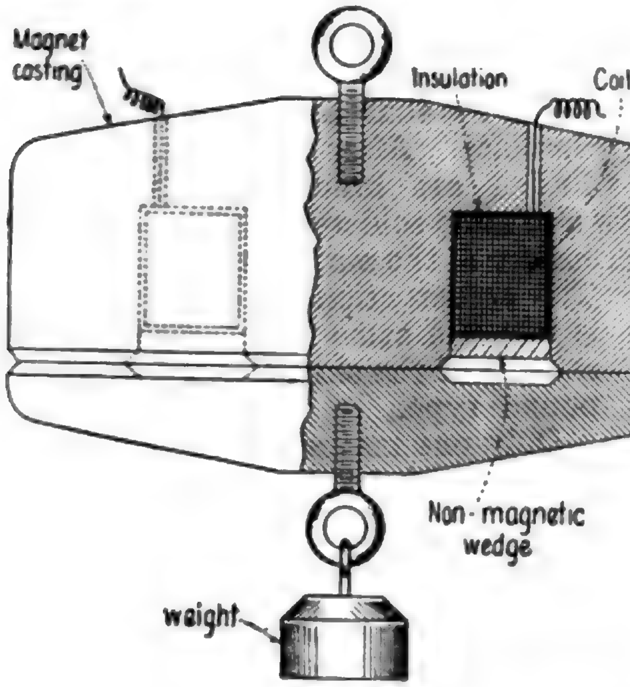
Conventional form of an electromagnet

The magnetic reluctance varies with the material used as core. It is practically greatest with air and least with well annealed wrought iron. It also varies in inverse proportion to the cross-section of the core. The above is rigidly true for air and approximately true, within certain limits, for iron.

The cores for alternating current magnets must be laminated. A laminated core is made up of a number of thin plates, as shown in Fig. 7. The core is built in this way, as otherwise current would be induced in the iron and this current would heat the core and cause considerable waste of energy.

In designing electromagnets, it must always be borne in mind that the attraction of an electromagnet for its armature varies as the square of the number of

lines of force passing through both, and it should then be endeavored to obtain the maximum flux that a current can produce; that is, to arrange a circuit with the least possible magnetic resistance.



General form of a large iron-clad lifting-magnet used with a crane or lift for a hoist

As a general rule, it will be found advisable to make the thickness of the coil about equal to that of the core; to make the yoke just long enough so that the coils will not interfere with each other when placed in position; and to make the core long enough to accommodate the necessary wire. In all coil winding proper insulation must be provided to prevent a short circuit. The kind of insulation depends on the size and use of a magnet.

In Fig. 8 is shown a cross-section of an electromagnet, showing the coils surrounding the core and a general scheme of the lines of force existing in such a magnetic circuit. The armature is shown out of contact with the magnet and considerable leakage flux is depicted. If the armature is brought into contact with the core, it will not only reduce this leakage, but it will increase the flux of the magnet by lowering the magnetic reluctance of the circuit.

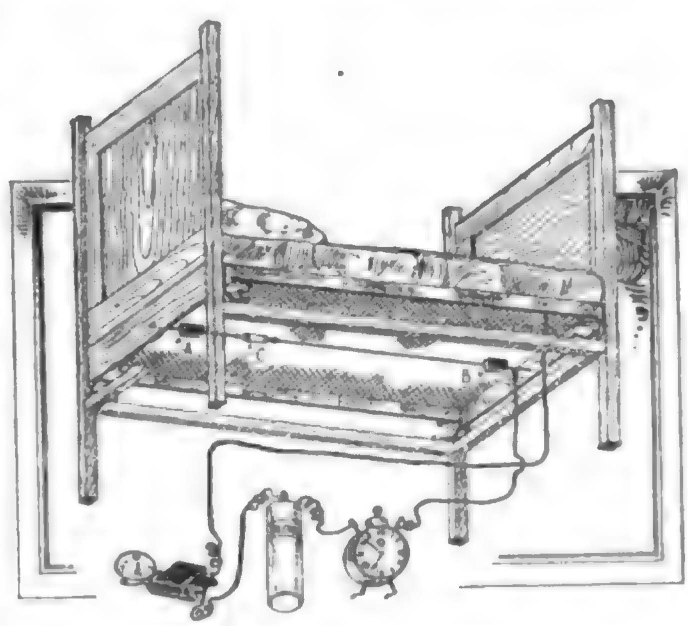
A few of the principal forms of electromagnets, including the horseshoe magnet, the electro-bar magnet, and the iron-clad magnet are shown in Fig. 6, 9 and 10.

The Sleeper Must Get Up to Stop the Alarm

THE growing habit of switching off the alarm clock and then sleeping a while longer made one commuter miss his train many times. He very easily overcame this difficulty, however, by making an attachment to his bed springs, as shown in the illustration, that compelled him to get up to break the electric current.

A simple frame was made of two brass spring pieces, stretched lengthwise of the bed, one on each side and just under the springs, with a third piece connecting them about 2 ft. from the head. These wires were properly insulated from the bed frame with pieces of fiber attached in the line as shown at *A* and *B*. A small turnbuckle *C* was used to keep the line taut.

A cheap clock made the electric connection at the time set, and a couple of dry batteries completed the device. The connections were simple, one wire was attached from the battery, through the bell to the bed springs, the other from the battery, through the clock to the insulated frame. The clock turned on the current at the time set. The weight of the sleeper caused the springs to touch the frame, as shown by the dotted line, so the bell rang and kept on ringing until he got up.—J. K. BURRELL.

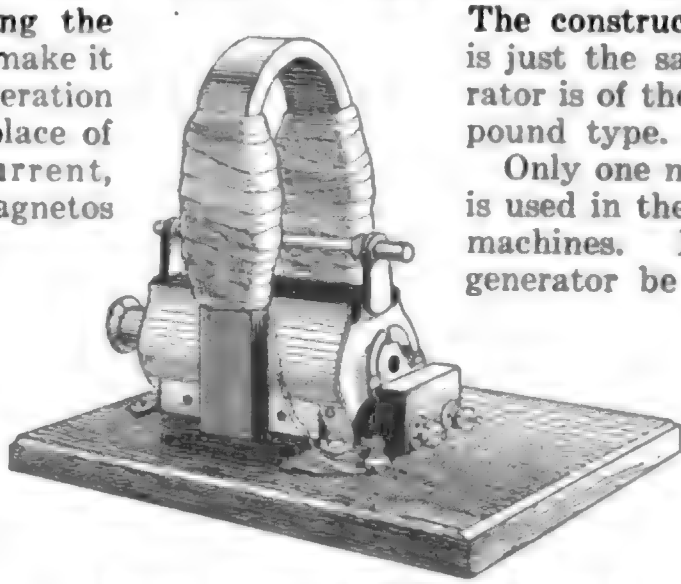


The weight of the sleeper makes the contact for the circuit on the bed springs

Making Small Generators from Telephone Magnetos

THE amateur electrician may construct very sturdy little direct current generators of either series, shunt or compound type from the parts available in an old telephone magneto which may be procured for a few cents from nearly any telephone exchange, especially in the rural districts. It does not matter whether the magneto is in a workable condition or not, providing the parts are all intact.

The first operation must be that of properly reconstructing the armature in order to make it adaptable for the generation of direct current in place of the alternating current, which telephone magnetos produce. First remove the fine wire which is wound upon the armature and replace it by winding each pole of the armature full of No. 22 single cotton covered wire. It is very necessary that both poles be wound in the same direction as shown in Fig. 1. It is of course, understood by amateur electricians that the smaller the wire contained on the armature of the dynamo the higher the voltage generated will be, with a corresponding decrease in the amperage. Telephone magnetos are designed to generate a potential of several hundred volts in order to overcome the high resistance of the line. This high voltage and low current value is not suitable for practical purposes, especially in the amateur's workshop. Hence, the necessity of changing the small wire on the armature to that of a larger size.



A finished generator which can be made from parts of an old telephone magneto

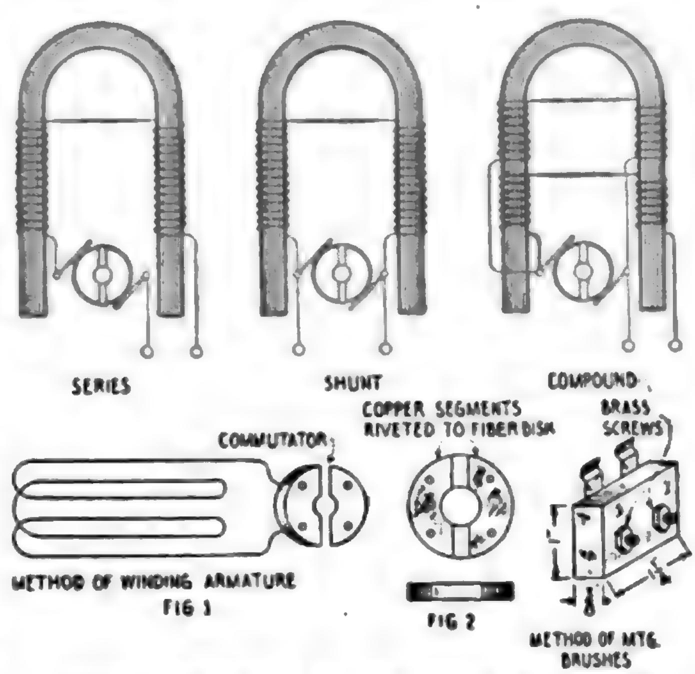
As the armature is a two-pole affair, the commutator will need but two segments. The commutator will be of the disk type as it is very simple to make and possesses certain advantages over the drum type which make it more adaptable for this purpose. Owing to the hollow shaft of the armature, which is used to bring the leads to the cummutator, it will be found rather difficult to fit a drum commutator to it. The details of the small disk commutator are shown in Fig. 2. The copper segments are fastened to the fiber disks by means of small brass brads used as rivets. The brads should be filed perfectly flush with the surface of the copper segments after being hammered into place. The hole in the center of the fiber disks should be a trifle smaller than the shaft so it can be forced on the shaft and made to remain rigidly in place. After the two leads from the winding are brought through the hollow shaft and soldered to the segments, the armature of the machine is completed.

The construction of the armature is just the same whether the generator is of the shunt, series or compound type.

Only one magnet of the magneto is used in the construction of these machines. If a more powerful generator be desired, two magnets may be used. In fact, the three magnets may be used together without any winding at all by merely taking the current off the commutator with two small brushes. The writer would advise, however, that either one or two magnets be used with a field winding. Aside from giving the mechanic a better understanding in dynamo construction, the types with field winding possess certain advantages over those without it. If the mechanic wishes a series wound machine, the field coils should be wound with No. 24 single cotton covered copper wire. A little more than $\frac{1}{4}$ lb. will be needed. Paper is first wound around the magnet to insulate it from the wire. It is not necessary to wind the wire on carefully or to make bobbin heads to hold it in place. It is essential, however, to have approximately the same amount of wire on each pole. It is also necessary to wind each field coil in the same direction. After the field coils are wound, they are given a coat of shellac and covered with friction tape, leaving the leads protruding for connections. It is also desirable to shellac the tape after it is wound on to make the winding as nearly moisture proof as possible.

The machine is now ready to be fitted with brushes. The brush system described as follows, like the armature, can be used on any type of machine—series, shunt or compound. The brushes are made from very thin sheet copper bent as shown in the sketch. They are mounted on a small fiber or hard wood block of the dimensions shown. Small brass machine screws hold them in place and also provide means for connections. Care should be taken in adjusting the brushes so they bear flatly upon the commutator surface which reduces the resistance of the sliding contact to a minimum.

After mounting the apparatus on a suitable base, the connections of the various parts are made as illustrated. It will be seen that the field winding is connected in a series with the armature, which fact gives the dynamo its name. An empty thread spool is forced on the end of the shaft to serve as a driving pulley. The dynamo may be driven by a water motor, gas engine or other means. If the experimenter has alternating lighting current available, a small 110 volt motor may be used to drive the generator. In this case, it makes an ideal motor generator for use on the experimenter's table for electrolysis, etc. A series wound dynamo, however, should never be employed to charge a storage battery as it is very likely to change its polarity and injure the cell.



Wiring diagrams for the different fields; also the method of winding the armature

To build a shunt wound dynamo, it is necessary to make a different field winding. The field winding of a shunt wound dynamo should have a much higher resistance than the armature winding so that it will have sufficient magnetizing power without drawing too much current. In this case, No. 30 single cotton covered copper wire should be used for the field coils. About ½ lb. is the amount needed. It is wound on in the same way, the only difference being that it is connected in shunt to the armature instead of in series with it. The method of connecting a shunt wound dynamo is shown in the sketch. This machine is ideal for charging storage batteries.

Compound wound dynamos are provided with two separate field windings. One winding, which is of fine wire, is connected in shunt across the brushes, while the other winding, which is of larger wire, is connected in series with the armature winding. The connections are plainly shown in the sketch. The fine wire should be wound on first and consists of ⅜ lb. of No. 30 single cotton covered wire divided equally between the two poles. After being given a coat of shellac, a layer of paper is placed over the winding. The second winding, which consists of ⅜ lb. of No. 18 single cotton covered wire, is then wound over the first After being shellacked, it is covered with friction tape and the machine is assembled.

A very good universal generator can be made by winding each one of the three magnets furnished with the magneto. One can be wound for a series dynamo, one for shunt and one for compound. The experimenter will then have a machine of any type by using the corresponding magnet over the armature. It is not necessary to arrange any mechanical contrivance to hold the different magnets in place as they generally fit tightly over the sheet iron frame that covers the armature. It will be necessary, of course, to use the proper connections for each different magnet.

These small generators, if properly constructed, should deliver from 20 to 30 watts of energy. This will depend largely upon the strength of the magnets.

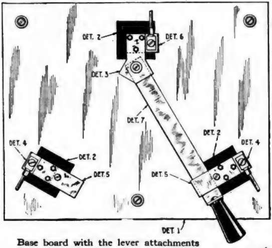
An Improved Design for a Grounding Switch

THIS article describes a short-throw lightning switch having the base of marble, and the contact supporting blocks of bakelite. Bakelite is a perfect insulator, marble is not. Marble is cheap, bakelite is not. The combination gives maximum insulation at minimum cost.

Raising the contacts from the marble eliminates surface leakage to a large extent. By having the contacts mounted with their flat sides in contact with the supporting blocks, alinement becomes automatic, because bakelite sheet is extremely accurate in thickness. By placing the contacts at the vertices of an equilateral triangle, minimum throw with maximum space between contacts is se[illegible]

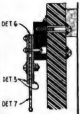
[illegible]mary of the material required is [illegible]s:

[illegible] Pc. 1 in. x 11½ in. x 14 in.
[illegible] ¾ in. Thick, 3 Pcs. 2 in. x 2 in. x ¾ in.
[illegible]pper, 1 Pc. ⅛ in. x 1 in. x 25 in.
[illegible] ⅛ in. thick, 1 Pc. 2 in. x 3 in.
[illegible] x 1½ in. Rd. Hd. Iron Cap Screws, 9 Req.
[illegible] 2¼ in. Rd. Hd. Iron Wood Screws, 3 Req.
[illegible] x 13/16 Fil. Hd. Brass Mach. Screws, 9 [illegible]
[illegible] Brass Acorn Nuts, 9 Req.
[illegible] x ⅜ in. Fil. Hd. Brass Mach. Sc., 3 Req.
[illegible] x ½ in. Rd. Hd. Brass Mach. Sc., 3 Req.
[illegible] x ¾ in. Rd. Brass Mach. Sc., 1 Req.
No. 14-20 Hex. Brass Nuts, 8 Req.
5/16 in. Iron Washers, 9 Req.
¼ in. Brass Washers, 3 Req.
No. 10 Small Pattern Brass Washers, 9 Req.
Felt Washers with 5/16 in. Center Hole, 9 Req.
Felt Washers with ¼ in. Center Hole, 3 Req.
3 100 Amp. Terminals.
1 Handle.
Wooden Blocks ⅝ in. x 1½ in. x 1½ in., 3 Req.



Base board with the lever attachments for the single throw switch

The switch can be made by the average amateur with ordinary tools. Get a piece of unpolished white marble for the base, from some marble setter or stone cutter, and chip it to size with an ordinary cold chisel; taking small "bites," so as not to crack it. Smooth up the edges with an ordinary coarse rasp, and finish them off with coarse emery cloth. Clean up the top surface with coarse emery, also, and file a bevel all around.



As your next step drill the base as per detail 1. This takes time, patience and labor. Drill the holes with an ordinary twist drill, using plenty of water as a lubricant. As the drawing shows, there are nine 5/16 in. holes for fastening the bakelite blocks to the base, and three ¼-in. holes to fasten the base to the wall or support. Be sure to drill all holes from one side, as the drill always chips out a small piece of marble around the hole when it breaks through.

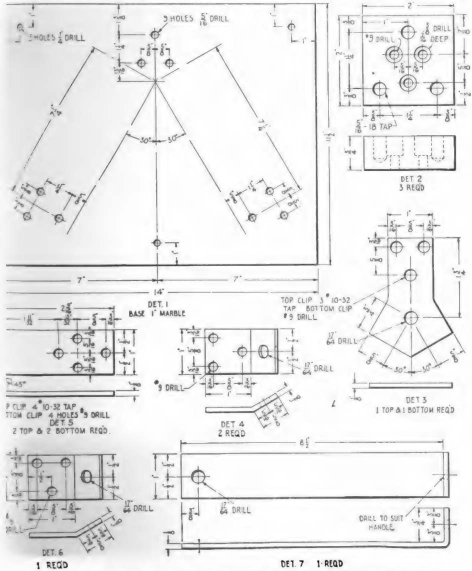
There are required three insulating blocks, 2 in. square, made out of ¾-in. sheet bakelite. You should be able to get the bakelite from any up-to-date dealer in wireless supplies. Bakelite is the best insulation for this purpose, as it weathers well, does not warp, and does not decompose with age. Cut the bakelite with a hack saw, file the edges smooth and polish it with a fine emery cloth and oil. Drill and tap it as shown in detail 2.

Four jaw clips are needed, two for the bottom and two for the top. Use bus bar copper 1 in. wide by ⅛ in. thick. Cut this to length with a hack saw, file the edges smooth, and file a bevel on one end, so that the blade of the switch will enter the jaw clips smoothly. After filing the bevel, drill the clips as per detail 5.

The two jaw clip spacers, and one ɪinge clip spacer, are also made from bus ɔar copper. Cut them to length, file the ·dges, and bend up one end in a vise. Drill he jaw clip spacers as in detail 4 and he hinge clip spacer as in detail 6.

Get some sheet copper $\frac{1}{8}$ in. thick, and draw an outline of the hinge clip upon it as shown in detail 3. Cut around it with a hack saw, finish it with a file, and drill it as indicated.

As shown in detail 7, cut off a piece of bus bar copper for the blade, $9\frac{1}{4}$ in. long, and drill a 17/64-in. hole $\frac{3}{8}$ in. from one



Details of the parts that enter into the construction of a grounding, single throw switch in which their combination gives a maximum insulation efficiency at a minimum cost

end. Make a right angle bend at the other end ¾ in. long, and drill it to take the handle. The handle should be large and substantial. It is best to buy it from some supply house.

Now you are ready to assemble the jaw clips. Clean all the clips and the blade with fine emery cloth before assembling. Lay the bottom clip in position on the bakelite block; next the spacer and then the top clip. Fasten all three securely to the block by means of three No. 10/32 machine screws, and lock the screws with acorn nuts. Assemble the screw which acts as a stop for the blade, and pinch the ends of the clips together, so the jaws will grip the blade firmly. The hinge clip is assembled in a similar manner. Fasten all three blocks to the marble base with the 5/16-in.-18 screws. Put a brass washer and a felt washer on each screw, in the order named, before assembling. Fasten the blade in the hinge clip with a ¼-in.-20 brass screw, and lock it with a ¼-in.-20 brass nut.

The next thing to do is to mount the switch. If you mount it in an exposed position, protect it with a weatherproof box. Place the switch so that the hinge clip is uppermost; and fasten the aerial wire to this. The lead-in to the apparatus and a No. 4 ground wire go to the two jaw clips respectively. Space the switch from the wall or support upon which you mount it, by means of three wooden blocks, about 1½ in. by 1½ in. and 1 in. thick. Drill a ¼-in. hole in each of the blocks; pass the three mounting screws through these and the base, turn them up tightly, and your switch is then ready for use.—W. H. Scheer, Jr.

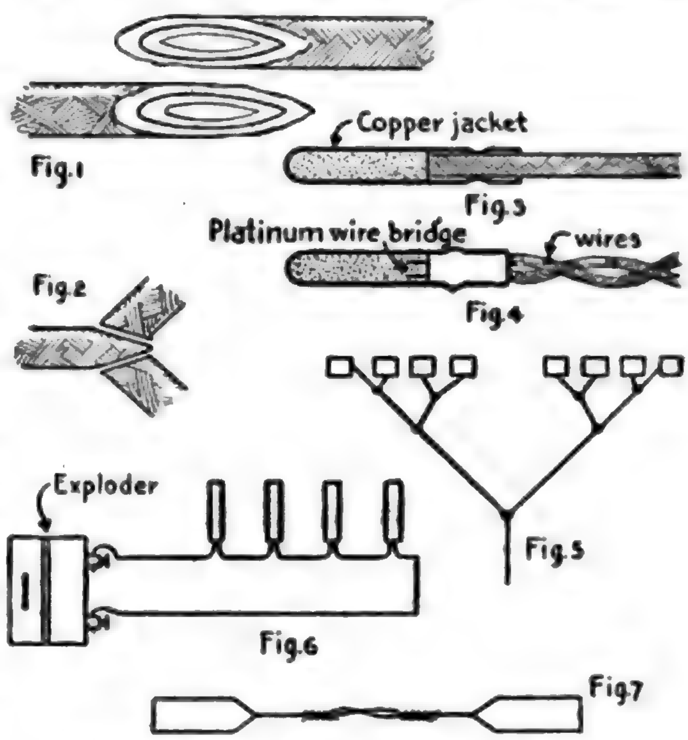
Killing Woodchucks with Deadly Dynamite Fumes

WOODCHUCKS may be easily exterminated by the slow burning of dynamite in the burrows. The kind of dynamite to use is the low grade ammonia. A stick of this, well saturated with kerosene, will smolder and give off a deadly gas, which when confined in the burrows, will asphyxiate any of the animals contained in them. After placing and igniting the stick, cover up the entrance to the hole tightly so that no air can penetrate or gas escape.

A Few Tips on Splicing Fuse for Discharging Dynamite

THE proper way to cut a fuse in order to splice it to another piece of the same kind or to splice a fast burning fuse to one that is slow burning is shown in Fig. 1. The fast burning fuse is usually fastened in the cap or detonator. The powder surfaces are placed together and lashed tight.

The proper way of slicing the fuse when two charges are to be exploded simultaneously from one main fuse is shown in Fig. 2. The diagonal cuts are used to



Splicing fuse to ignite a charge of dynamite. Double splices for branches in fuse line

give greater powder surface and to insure the fire traveling from one piece to the other.

The detonator cap for a powder fuse is shown in Fig. 3. Fig. 4 shows the detonator cap for an electric exploder, while Fig. 5 shows the method of splicing fuses which simultaneously explode several charges—each dot in the drawing indicating a splice.

A method of connecting the charges when they are to be fired with an electric exploder is shown in Fig. 6. All wires are securely fastened to the charge to which they are attached and the ends are spliced together as shown in Fig. 7. The lead-in wires should never be connected with the exploder until everything is ready for the shot.—Geo. M. Petersen.

Wireless Work in Wartime

VIII: The Power Circuits of the Transmitter

By John L. Hogan, Jr.

IN last month's article a general review of the technical fundamentals of radio communication systems was given. The two basic methods of producing alternating current were described in brief, and two types of radio transmitter were shown. All this was preliminary to this second group of articles, which will include six monthly instalments devoted to telegraphing.

Since large numbers of skilled operators are and will be needed by the Naval and War Department radio services, and since the more familiar these men are with the practical and technical basis of radio apparatus and design, the more useful they will be, this new group of articles will continue to point out various successful arrangements of radio apparatus and the best ways of handling them.

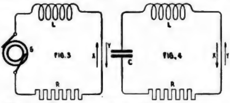


Fig. 30.—Radio transmitters which produce wave-groups in this way are of the damped wave type

Classification of Transmitters

Detailed attention must first be given to the transmitter. Each sending apparatus for radio telegraphy may be classified into one of two main groups, according to the type of wave emitted from the aerial system. If power is applied intermittently to a condenser, which is first charged to a high potential and then allowed to discharge with oscillations through an inductive circuit (as shown in Fig. 30, reproduced from last month's article), there are produced currents which more or less rapidly die away [illegible] amplitude. The application [illegible]ts to a radiating aerial [illegible] circuit constants are ad[illegible] alternations at ex[illegible]dio) frequencies, results [illegible] groups of waves. The [illegible]ity of the alternations [illegible] waves dies away in accordance with the current-groups which produce them. Radio transmitters which produce wave-groups in this way, one for each charge-and-discharge of the condenser, are of the damped wave type, which we may call Class I. This class includes practically all of the numerous variations of spark and buzzer sending arrangements; and the class may be subdivided by reason of the particular characteristics of each form of spark transmitter.

When waves are generated by means of an apparatus which supplies power to the aerial system as fast as it is radiated, so that the waves never die away, there are no wave-groups produced. Energy is sent off into the ether continuously, and the amplitude remains practically constant as long as the transmitter is in operation. Such senders, which include the radio-frequency alternators and arc transmitters, are of the undamped or sustained wave type, which may be called Class II. As with Class I, there are many different sorts of instruments which give this same general result and which may be made the basis of sub-groups under the main classification of undamped or continuous wave senders.

The damped wave transmitters are used far more than the undamped wave type at the present time. They are particularly suitable for short wave transmission. Speaking broadly, the undamped wave is superior to the damped wave for any type of service, but suitable sending instruments for generating the short undamped waves preferred for short distances have only recently been developed. Consequently, by far the greater number of ship stations, as well as of shore stations used for small or moderate

distances, are of the damped wave classification. It will be best, therefore, first to consider the damped wave transmitters in detail.

The Simple Spark Transmitter

The "plain aerial" transmitters represented by Fig. 31, also reproduced from last month's article, are not much used at present. In the original forms there were no loading inductance coils *L*, and as a result the groups of waves

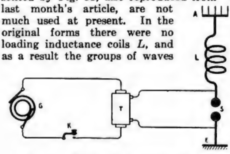


Fig. 31: The plain aerial transmitter is not of a type that is used at the present time

emitted were highly damped (that is to say, died out very quickly) and therefore were not suitable for sharp turning. Even when the loading coil is added to increase the persistence of the wave groups (i. e., to make them die away less rapidly), the various power limitations, as well as the difficulty of securing high electrical efficiency, helped to bring about the disuse of this type of spark transmitter.

The main objection to the "plain antenna" sending arrangement is that the spark-gap itself is directly in series with the antenna-to-ground circuit. Consequently, all the oscillating current of the aerial circuit must pass and re-pass through this gap as it oscillates back and forth between antenna and ground. Since the spark-gap possesses a moderately high resistance, radio frequency energy passing through it is wasted in producing heat. A further objection is that the power available for producing oscillations is limited by the capacity and insulation of the antenna, and that any leakage in the aerial insulators puts a sharp restriction upon the ability to store power before each spark passes and each train (or group) of oscillations starts.

By using the coupled two-circuit transmitter of Fig. 32, these difficulties are overcome wholly or in part. Obviously, the spark gap is no longer in the aerial circuit, and therefore a large portion of the losses due to that arrangement are eliminated. Further, the ability to store power before each spark passes is determined by the capacity and insulation of the secondary condenser *C*, and hence the amount of energy in each oscillation-group is no longer dependent entirely upon the antenna.

All of this will perhaps be made more clear by considering successively the several circuits in the transmitter, both as to their arrangement and operation. Two general arrangements of the power circuits are much used. In the first, there is an alternator located at the radio station and forming part of the radio equipment. This is the usual practice in commercial stations. The second arrangement has alternating current power furnished over long lines from a distant central power station, in which case the alternator supplies a general lighting and power load, and is not strictly a part of the radio outfit.

The Power Circuits

Since the vast majority of commercial stations, and nearly (if not quite) all military and naval plants, have special radio generators at the transmitting points, this type should be taken up first. It is of little importance how the al-

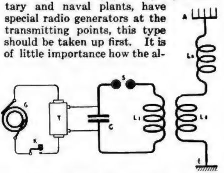


Fig. 32: The coupled two-circuit transmitter overcomes difficulties from the plain antenna

ternating current generator is driven. An electric motor on the same shaft is the most common arrangement, but sometimes steam turbines or gasoline engines, or even geared hand-drives, are used. In every case, some mechanical power is provided for the purpose of rotating the moving part of the alternator, and alternating current of the voltage and fre-

quency desired is delivered from the armature terminals of the machine.

Let us consider a typical spark-sender installation such as is used aboard ship and at many land stations. Direct current electric power is provided from the engine room (or by a public service corporation), and wired to the radio station. Here it passes to a control switchboard and a motor-starter, which is associated with the direct-current motor used to drive the alternating current generator for the radio transmitter. In Fig. 33 the power circuits of such an installation are shown, reduced to their simplest form. The direct current line comes in at L_1 and L_2, and usually operates at a voltage of 110 or 120. As shown in the diagram, the lines lead directly to two fuse-wires W_1 W_2, which serve to protect the apparatus by "blowing" or melting in case too much current is drawn from the line (by reason of a short-circuit or other abnormal condition). From the fuses, the connection runs to a double-pole line switch *LS*, which is used to disconnect the entire motor circuit when the plant is not running. The motor is usually stopped by pulling this switch open. When the switch is closed, the power is applied across the terminals of a voltmeter *VM*, which will always show the voltage of the direct current line if the fuses are in good condition and if the circuits are all right up to this point. From the voltmeter the

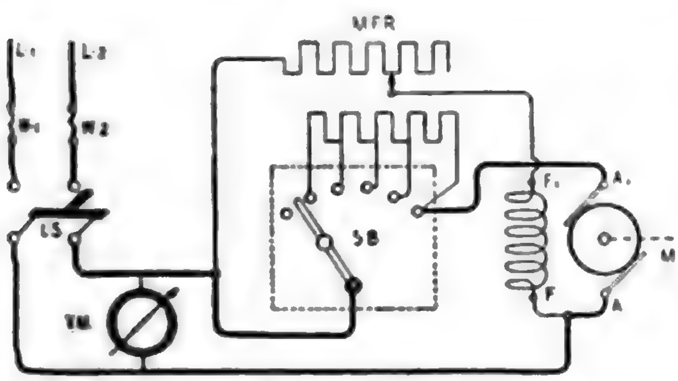


Fig. 33: In most modern installations an automatic electrically-controlled starter is used

wires run to the motor itself, shown at the right of the diagram Fig. 33, passing through a motor field rheostat *MFR* and a starting box *SB*. The starting box illustrated is of the simple hand-controlled type. In most modern installations an automatic, electrically-controlled starter is used, but the principle is the same.

Connections of the Motor

It will be noted that the motor is shown with two field terminals marked F and F_1 and two armature connections A and A_1. The armature connections

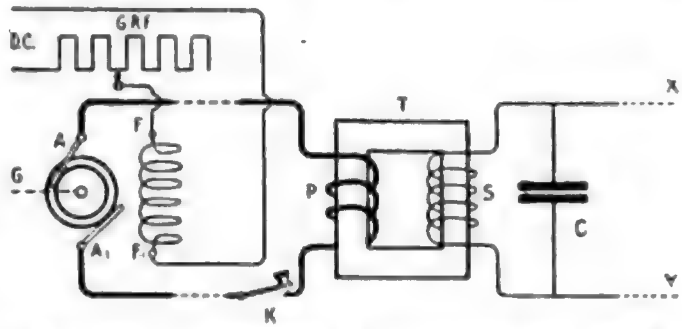


Fig. 34: In addition to the generator itself the circuits of the transmitter are shown

lead to the brushes, as shown, and current applied to them reaches the low resistance armature windings through the rotating commutator. The field is a high resistance stationary winding connected directly across the direct current line through the terminals F F_1. It is often called "shunt field" to distinguish it from a low resistance winding called the "series field" which is sometimes used, on compound-wound motors, in series with the armature. One terminal of the field and one of the armature are usually brought together at a "common" point, as illustrated by *A F* in the figure.

The starting box *SB* contains a variable resistance which is connected in series with the low-resistance armature windings. As the contact arm is pulled over slowly, less and less of the resistance remains in the circuit, and the motor turns over faster and faster until (when the line is directly across the armature and all the starting resistance is cut out) full speed is reached. On most starting boxes the contact arm is provided with a spring tending to hold it in the initial or high-resistance position, and a small retaining-magnet which keeps it in the running position so long as the line voltage is normally high. If the current is cut off by opening the line switch, *LS*, or through an interruption of the power circuit outside the radio station, this retaining magnet (often called a "no-voltage release") will let go, the spring

will pull the contact arm back to the starting position and the motor will not only stop but will be protected against the large surge of current which would flow if, when the motor was not revolving, the full voltage were applied across the armature with no starting series resistance.

With the motor brought to full speed by cutting out the starting resistance, the revolutions per minute may be adjusted by use of the motor field rheostat *MFR*. When this resistance is all cut out, the maximum current flows through the field, and the motor revolves most slowly. Conversely, by cutting in more of the field resistance the motor field current is reduced, the field is weakened, and the motor speeds up. If the field is made too weak, the motor will lose power, and though it will run at very high speed when no mechanical load is thrown on it, the speed will be much reduced under load and the operation will be unsatisfactory. Thus it is evident that too much field resistance cannot be used. For a reasonable range, however, the speed may be raised by increasing the resistance in the motor field circuit.

The Generator Circuit

This brings us to the generator *G* of Fig. 34. The generator is usually mounted upon the same shaft as the motor, as is indicated by the dashed line extending to the right from Fig. 33, and to the left from Fig. 34. Of course the two machines then turn at the same speed, and changing the motor speed by use of the motor field rheostat alters the generator speed correspondingly.

The generator, like the motor, has two windings; one is for the field and has its terminals marked F F_1, the other is the armature with connections A A_1 in Fig. 34. In the generator, however, there is no common terminal; the field windings carry direct current supplied from the *DC* line through the generator field rheostat *GFR*, and the armature windings produce the alternating current which is used in the radio transmitter. The frequency of this output of alternating current is determined by the speed of the generator, and may be reduced by slowing down the motor through the motor field rheostat. The voltage of the alternating current, which may be measured by connecting an A.C. voltmeter across the armature at A A_1, is varied by changing the strength of the generator field; the stronger the magnetic field, i. e., the less resistance in the rheostat *GFR*. Hence the greater the field current, the higher the alternating voltage at A A_1.

Adjustment of Frequency and Voltage

In addition to the generator itself, Fig. 34 shows the power circuits of the two circuit spark transmitter of Fig. 32, or, in fact, of any sender which uses alternating current to charge a condenser. The armature or output terminals of the alternating current generator *G* are connected through the signaling key *K* to the primary *P* of the transformer *T*. The secondary *S* of the transformer is connected directly across the high-potential condenser *C*, which in turn may discharge through the wires *X* *Y* to a spark-gap and inductance coil which are not shown in the figure. By varying the two field rheostats, alternating currents of any frequency and voltage within the range of the apparatus may be applied to the condenser *C*. The desirability of having such adjustments available will appear when their effects are described in later articles.

In some coastal commercial radio stations, and in most amateur plants, the alternating current is supplied from a central public service station at a distance. This makes it difficult to adjust the power circuits so as to give the best operation under the most efficient conditions, since the frequency cannot be changed and it is hard even to alter the voltage. When power is supplied in this way, and is used without conversion through rotating machinery (which gives a special and controllable generator at the wireless plant), the line conditions usually vary so much from moment to moment that it is not practicable to maintain the rather critical adjustments which give the best results. Consequently, the motor-generator installation is much to be preferred.

In the next few articles the action of the high voltage and radio frequency circuits, as well as several types of spark gap, will be explained.

(*To be continued.*)

72 Cents

Taxed for not living in New York

Unless you help to repeal the oppressive Postage Zone Law it will penalize a subscriber in California to the extent of 72 cents for postage alone on a year's issues of Popular Science Monthly

"United we stand, divided we fall," has a new significance. Now, as never before, this country should strive for national unity.

Yet Congress has passed a law that will split up the country as surely as though Chinese walls divided it into sections. After July 1st, 1918, in accordance with the new law, magazines, newspapers, and all other periodicals are to be mailed on the Zone System and at rates very much higher than at present.

The postage on Popular Science Monthly for a year is now about 15 cents—but when the new law is in full effect the postage will range from 24 cents in New York—to 72 cents on the Pacific Coast. The cost increases the further you live from New York.—And most periodicals are published in or near New York.

Give Up Magazines?

How would you like to be deprived of all your magazines and periodicals? Well, there are hundreds of thousands of citizens, perhaps millions of them living in the farther away zones, who will be obliged to give up their magazines because of the increased expense.

Magazines bring to the reader the achievements of the world. They bring new ideas, suggest new lines of thought. They keep the East abreast of the West, and the South abreast of the North. They are the great Educators of America.

Congress many years ago recognized all this and made a postage rate of 1 cent a pound for magazines for all parts of the country. Since then America has grown and prospered as no nation in the world ever did before and has kept united, and is united today as is no other great nation of the world.

Shall we now start the deadly process of splitting up the nation?

You and you alone can prevent the zone system from going into effect. Write to your Congressman and Senator about this. Tell them you object. The Editor of this magazine will be glad to give you their names and any further assistance you may desire.

will pull the contact arm back
ing position and the motor
stop but will be prote
large surge of current
if, when the motor wa
full voltage were
armature with no
ance.

With the mo
by cutting
the revolu
adjusted
rheostat
is all c
throu
most
mor
fiel

hman, in a letter to the Editor of the ***Popular Science Monthly***, for trapping raiding enemy airplanes. This could be carried out to be made of piano wire, and are to be suspended from balloons. be barred by anti-aircraft guns. The enemy pilot is to be forced airplanes through open lanes which he will consider avenues of up before him. It is too late to turn. He must face death the great net or by a hail of machine-gun bullets from his pursuers

Popular Science Monthly

225 West Thirty-ninth Street, New York City

Vol. 92
No. 4

April, 1918

$1.50
Annually

Fishing Airplanes from the Sky in Nets

An ingenious plan for catching enemy airplane pilots in nets of piano wire

By Carl Dientsbach

FOR many years the scientists of European and American weather bureaus have explored the atmosphere kites from which thermometers, barometers, recorders and wind-measurers are suspended. These instruments are like pens in the hands of the air; for the air writes down how hot and cold it is, how much it weighs, how fast it is moving, and how wet it is. The kites are flown from thin but very strong piano wire. Whole batteries of kites are sent aloft and kept there for days at a time.

These piano wires were considered so dangerous to aerial traffic before the war that in the weather news published by the German Government for the benefit of aviators, the approximate location of the kites, which naturally changes with the wind, was never omitted.

If a few piano wires can be so dangerous in peace, what might not happen if a more elaborate wire system were deliberately resorted to in time of war for the purpose of netting high-powered flying machines? That is the idea of an Englishman, Mr. F. J. Lane, who wishes us to place it before the readers of the POPULAR SCIENCE MONTHLY. The present writer proposed the same system before the war.

His aerial entanglement is to be supported in feeble winds preferably by captive balloons or by kites. It is obvious that the system would hardly succeed in broad daylight, but it would be unquestionably efficacious at night, provided the enemy could not see the uppermost of the kites or balloons which support the netting. The wires would be provided with barbs, and their effect would be disastrous if they should ever be caught in a revolving propeller.

To cover great spaces the meshing of the net would be very coarse, measuring perhaps fifteen feet to the side. Indeed, the coarser the mesh the more likely is the plan to succeed, for the more difficult will it be to detect the piano wire.

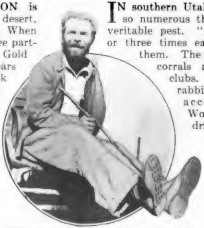
The great vertical space to be enclosed is undoubtedly the chief difficulty encountered, even though we may consider the lower altitudes amply barred by anti-aircraft guns. An airplane has an up and down movement of miles; a submarine of only two hundred or three hundred feet. The success of the net depends clearly on driving the enemy pilot by gunfire or fighting craft into seemingly open lanes so ingeniously laid out that he never suspects the fate which is likely to befall him and regards the avenue as a means of escape.

Those who are familiar with the history of the airplane will remember the experiments made by Sir Hiram Maxim with his enormous, daringly conceived flying machine. During the course of these experiments a wire stay broke. In doing so it sheared off the propeller blades as if they were cardboard. Had the machine been actually flying in the air, it is easy to imagine what would have happened. And so with the enemy airplane that plunges into the net that Mr. Lane proposes. Any enemy pilot would crash to a ghastly death.

Consider Joe's Non-Skid Shoes. They're Made of an Old Tire

FURNACE CANYON is on the edge of the desert, miles from civilization. When Joe Boucek and his three partners were bitten by the Gold Bug about twelve years ago, they began to look around for the most forbidding piece of country in which to prospect. This search ended in the selection of Furnace Canyon.

Until a few weeks ago no automobile had been able to penetrate the wilds of this canyon. The road was little more than a burro trail. The boulders were many, the sand holes deep, and the grades heavy. Joe was present when the first car broke its way into the canyon. When he spied those black-tread non-skids he let out a yell. At last his "sole leather" problem was solved. The morning after securing a discarded tire Joe appeared with his shoes non-skidded. He asserts that he now has enough material to last him ten years. By that time perhaps another automobile will "get through."



Why doan' you-all w'ar non-skid shoes like we-uns? They're shore the best ever

Utah Kills Four Thousand Rabbits at a Time

IN southern Utah the jack rabbits are so numerous that they amount to a veritable pest. "Drives" are held two or three times each winter to capture them. The rabbits are driven into corrals and then killed with clubs. Three or four thousand rabbits are shown in the accompanying picture. Would that Utah would drive rabbits toward the office of the POPULAR SCIENCE MONTHLY on a meatless Tuesday! We'd be there!

In some western states steps are being taken to utilize these rabbits on a larger scale than ever. There seems to be no reason why the rabbit industry may not become a large one in the near future, in order to help solve the question of the high cost of living.

Apparently the question of catching them solves itself. The only thing that would have to be thought out and arranged for would be their packing and shipment to the various markets.

Judging by the number shown in the picture, the rabbits must have adopted the faith of the founder of Salt Lake City.

B... of a "drive" in Utah. T... as above, and clubbed

The "Goofa" Is Now a Modern Side-Wheel Ferryboat

OVER on the River Tigris in Mesopotamia (Eastern Arabia) English soldiers are having unusual experiences in adapting ancient utilities to modern uses. One of the first institutions to receive their attention has been the venerable "goofas," or ferryboats, which natives have used unchanged for thousands of years. The English soldiers put paddle wheels on the "goofas."

Rub-a-dub-dub, three men in a tub. Not exactly. This is an army transport used on the River Tigris

"Goofas" are perfectly round in shape and made of willow limbs and twigs, just like a large basket. The outsides are covered with skins.

Navigating a goofa in its unimproved form must be akin to floating around on a magnified butter chip. When ordinary paddles are used as motive power, the goofa has a disconcerting habit of going off in any direction but that desired. Since it has no keel, or other directing device, it is difficult to keep it on a given course. But with paddle-wheels the goofa crosses the river with unprecedented directness.

Simple cranks and the sturdy arms of the soldiers furnish the motive power.

The fleet of goofas has been duly numbered for identification and is doing yeoman service in the Far East for moving supplies.

Camouflaged Observation Towers Used in Flanders

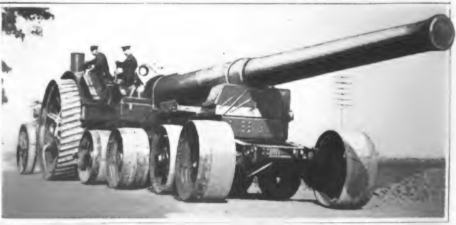
IN low, marshy Belgium, half flooded as it now is to interrupt the course of the Germans, there is almost no natural cover for observation posts. Camouflage is a necessity.

The two observation posts, here illustrated, were erected about a mile and a half behind the front lines, one at an eminence of sixty feet, the other three feet lower. A situation was chosen where there was one natural tree. The two towers are so camouflaged that a cluster of what seemed to be three trees was presented to the enemy's eye.


When is a tree not a tree? When it's an observation tower. More camouflage as practised in Belgium

These observation towers can be speedily built and as speedily dismembered. All of the parts are easily transportable, and require no special lifting apparatus to haul them into place. The material used is wood. The joists are held together by iron bolts.

The width of the towers is eight feet. On their top platforms are placed the instruments, necessary for artillery observations. Steel wire braces are attached from four angles, to steady the structure.



© Underwood and Underwood
A mammoth tractor of great power and two trailer trucks haul the monster guns to the front over the splendid roads of Flanders—roads that have been reconstructed by the Engineer Corps

How the British Hauled Their Giant Guns to the Flanders Front

THE transportation of one of the enormous guns used in the present war is a task which presents great mechanical difficulties. The weight of the guns and their great length make even their transportation by railroad anything but a simple matter. But railroads are not always and everywhere available. When the front is advanced, the big guns must be carried on to be used in the following artillery operation.

It would be absolutely impossible to transport the guns in their entirety. They are taken to pieces and transported. The gun itself, the heaviest part and the one most difficult to manage, is carried upon trailers with broad wheels, pulled by a gigantic tractor resembling an overgrown steam roller. The picture shows a twelve-inch naval gun and gives a good idea of the length and caliber of this terrible instrument of destruction which is capable to hurl tons of steel a distance of many miles.

The roads are excellent, as the Engineers follow up the advances and reconstruct them.

She Weighs One Hundred and Twenty-six Pounds, But the Paper Held

THE athletic girl in the picture, Miss Lorna E. Stewart, of Kalamazoo, Mich., is not a motion picture star doing some hair-raising melodramatic "stunt." She is merely testing the tensile strength of a certain kind of parchment paper by suspending her weight of one hundred and twenty-six pounds from a loop made from a three-inch strip of that paper.

Swinging from a strip of paper

The paper used in this test was vegetable parchment paper taken out of the stock of a manufacturing concern in Kalamazoo, Mich. It is intended for important documents, diplomas or records which are expected to last a great many years without deterioration. Such paper may be boiled, soaked, frozen, buried underground and subjected to abuse that would destroy ordinary paper, without being damaged in the least. Unlike ordinary paper, soaking in water makes the paper tough instead of soft. This is the highest quality in papers, which range all the way from this to newsprint and wrapping, and the familiar blotting paper.

Listen to the Nose Flute of the Untutored Filipino

IT is not an uncommon spectacle to see a colored man play a harmonica with his nostrils. When it is done, however, it always awakens a certain degree of wonder. Among the Filipinos a flute is never played in any other way, and it would create as much surprise in that country to see a man play a flute with his mouth. Why they see fit to play with the nostrils instead of the mouth we do not know. Moreover, they do this with the greatest ease, and can play the general run of music except the very fast rag time. Dare we perpetrate a pun and say that it must be a nose-pipe?

Nasal music of an unfamiliar kind

Traveling in the Oilfields with a Possible Earthquake

RIDING over rough country roads in a spring wagon loaded with nitroglycerin is an occupation that is not likely to appeal to the average man, yet there are those who make it their business to carry explosives and who become so accustomed to the hazardous work, that they scarcely give a thought to the risk of traveling, so to speak, with a potential earthquake.

© Brown and Dawson

The stock-in-trade of a "well-shooter." It consists very largely of enough nitroglycerin to raze a town

In the oil districts of Pennsylvania, Texas or California you may meet vehicles like the one in the picture, traveling slowly along the country roads. The body of the wagon rests upon a system of springs, which absorb all sharp shocks that might cause the explosion of the nitroglycerin. The load consists of enough nitroglycerin to "shoot" several oil-wells and of the necessary tubes, tools, etc. The tubes are filled with nitroglycerin and cautiously lowered into the borehole of the well. The uppermost tube has at the top a firing head which is exploded by a falling or sliding weight, called the "go-devil" and sets off the nitroglycerin charge. From four to six quarts ordinarily constitute a charge, but larger charges are used.

Electric Blasting Without Blasting Machine

THE safest and most convenient way of firing charges in blasting is by using the electric spark, and blasting machines for generating the required spark are in general use wherever blasting operations are carried on. Farmers, who often have occasion to do blasting of stumps, rocks, etc., but not often enough to justify the expense of purchasing a blasting machine will be interested in the suggestion offered by Mr. W. A. Saunders, New Hampshire, who made shift to fire a circuit of five charges of dynamite with a spark obtained from a dry-cell battery of his automobile, when no blasting machine was available on a certain occasion. This is a handy wrinkle to be acquainted with on occasion.

Off the Well-Beaten Paths of Tourist Travel

Street of David leading to the Bazaar in Jerusalem. Even donkeys find it difficult

Photos © Newman Traveltalks and Brown and Dawson

Alaskan winter travel. Following a frozen river in the wilderness to its headwaters

Street in the excavated portion of Pompeii. It shows the ruts worn by the wheels of chariots in [illegible]s gone by. The city was overwhelmed so suddenly that things were caught "all standing"

Scenes One Finds "Way Out at Back of Beyond"

Snow plow at work in one of the passes of the trans-Andean Railroad, South America. In the winter snow causes much trouble

Pyramids and the Great Sphinx in the desert of Gizeh, inaccessible to automobiles

The Great Wall of China which, it is said, might be made into a fine automobile road

Zigzag walk leading to a tea house in China, warranted to keep away all the evil spirits

Raising Money for the Red Cross

These *papier-mâché* figures were placed in the Liberty Mall, Boston Common, as a mute appeal for Red Cross contributions during the recent drive in historic Boston

Photo © Underwood and Underwood

Tableau illustrating the war work of the Red Cross. This realistic group was shown on a big float during the Red Cross pageant recently held in Philadelphia

The wives and daughters of the employes of the Bronx Zoo, New York, have organized a Red Cross auxiliary and sew and knit daily in the lion house. Leo doesn't count

© Int. Film Serv.

Still Other Methods of "Getting It"

San Francisco society girls acted as "bell hops" for the benefit of the Red Cross, and are shown here displaying their "tips" stuck on adhesive tape as trophies

© Int. Film Serv.

Liberal donations by passing pedestrians were thrown upon the stretcher of the Russian ambulance stationed at the New York Public Library

Assemblyman Irving W. Glover, of Englewood, N. J., auctioning a lump of sugar for the Red Cross. It was sold for $100. How the cost of living is advancing!

S. Vaselakos, a Greek peanut vendor in Washington, D. C., contributed the net earnings of his stand during an entire week to the cause of the Red Cross fund

© Int. Film Serv.

Woman-Power Takes the Place of Man-Power

Women street railway conductors in New York are employed on many lines and they are a success

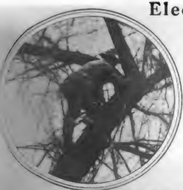
One of the "Conductresses" enthroned upon her perch behind the cash box in her car

The prospective conductors are required to go through a course at the school conducted by the street railway company for the training of their new employes

Photos © Press Illus. Serv.

Before starting from the barn in their cars on their initial trips the feminine conductors, just like their male predecessors, are handed their orders

Electrical Eavesdropping by the Signal Corps of the United States Army



The dictagraph receivers are put anywhere they will be handy. Here is one being placed in a tree top

Listening for the sound of operations by enemy sappers. This often entails a great deal of danger and discomfort

Crawling up to an enemy trench to place a transmitter, which is cunningly camouflaged in a battered tomato can

A trench receiving station where the conversation and movements overheard by the transmitter are noted

Photos © Western Newspaper Union

Where "distance to the view." of interesting the fine art of

Need a range of mountains? W picture the hills are pure fabric mountain ranges like mushroom

Photos by [illegible] C. P. I.

Italians building a strange and wonderful structure for the benefit of Fritz. In this branch of the war game the quotation "things are not what they seem" applies very aptly. Any given thing is likely to be anything else in the world—apparently

© Underwood and Underwood

A corduroy communication road with a deceptive screen of foliage. It looks crude enough here but not when seen from the sky

From an airman's point of view, this road gives the appearance of mere floating clouds, by virtue of the burlap stretched across it

lends enchantment
Here is a group
examples of
war camouflage

ertainly—right away, sir. In this
tion. The camoufleurs can grow
if the necessity should arise

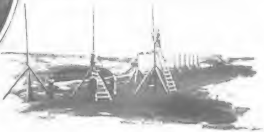
Photos Int. Film Serv. (C) C. P. I.

Even dressing-stations are not immune from Boche attack, and grim experience has taught the advisability of hiding them. This particular station among the mountains is hidden by a tent like piece of canvas, painted to match the surroundings

© Kadel and Herbert

This is an absolute work of art. It traverses the Astico Valley, and is truly making very much of a virtue of necessity

The commencement of a camouflage screen is much like the setting up of a "set-piece" on Fourth of July. Here the skeleton of a road screen is going up. Later the canvas will be applied and suitably painted with a self-effacing color scheme. The object of this particular piece of protective coloring is to screen off a road so that troops and supplies can be moved along it while hidden from the enemy's direction by the skilfully painted screen.



The Seductive Cigarette in the Making. Its

Photos © Int. Film Serv.

The girl in the picture is feeding the cigarette-making machine, spreading the cut tobacco to insure even supply to the mechanism

Expert girl sorters carefully select from the stock the leaves which are to be combined to give the desired blending of the tobacco

The leaves selected for the blend are turned over to the cutter, who is here at the cutting machine, preparing the tobacco for the cigarette machine

Evolution from Leaf to Finished Product

Each tobacco bale must be thoroughly inspected and classified by an expert, before the tobacco can be selected for the desired blend

This shows the delivery end of the cigarette machine. The cigarettes, completely finished and ready for packing, are neatly piled

The deft hands of girls fill the boxes with the counted number of cigarettes, label, wrap and pack them in paste-board containers for transit

New York's Food Scouts Commence Experiments

These children, all under weight, are being fed the correct kind of lunch every day, free, to prove the necessity of hot, balanced lunches for children. The menus are arranged by highly skilled dietitians

Weighing in the food scouts—all boys. Dr. Morris Stark, one of the chief experimenters, is seen examining one of the boys while another is being properly weighed

"T. R." is interested in the experiment—so interested that he went and weighed the boys personally. Here he is seen "on the job." He shook hands with all the boys

The Passing of New York's Coroner's Office

Photos © Underwood and Underwood

Here is the safe at the old New York coroner's office, containing valuables, money, etc., found on dead persons. Its custodian, Edward Doonan, is the man with the guns

These gentlemen are Messrs. LeBrun, clerk, Feinberg, coroner, and Doonan, clerk. The guns have all figured in inquests and used to make a very interesting collection

Cabinet containing poisons, razors, gas tubes, knives, ropes, etc., with which persons have committed suicide in Manhattan. All these relics were destroyed when office closed

The Girl Brickmakers, at

The world's largest brick plant, at Peterborough, England, closed about two years ago owing to shortage of labor, is now reopened with women. Bricks are being put on slides which convey them to wagons

The terminations of the above slides. The girls are taking the bricks off and stacking them into the railway-trucks ready for conveying to their destination. The girls are most business-like and work goes smoothly

Photo © Press Illus. Serv.

Here the molded bricks are being neatly stacked in the kiln ready for burning. They are brought up to the kiln on a narrow-gage railroad

Peterborough, England

Here is the light railroad in operation. The girls who provide the motive power will certainly develop muscles and physiques that will prove excellent arguments in future domestic mix-ups

The molding of the bricks is done by machine. This illustration shows how they are removed from the molding-machine

And even regular laborers' work does not scare these enterprising women. Here are two husky girls trundling their barrows

No Rest for the Peaceful Oyster Even in Winter

A big haul of oysters, dredged in midwinter from the beds near Oyster Bay, L. I. Hooverizing other foods has created a demand for the mollusk

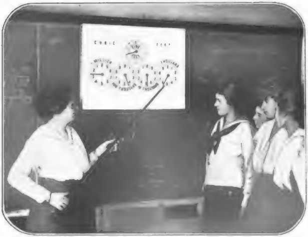
For the first time in history oyster dredging was carried on in winter upon the frozen Long Island Sound. The picture shows the dredgers at work. Considerable amounts are obtained

Photos © Int. Film Serv.

The oysters dredged up are loaded upon a sled which is pulled ashore by an automobile and then shipped to the New York market for distribution. Here we see the "rig" in operation

Shelter Bridges on the Line Near Dixmude

This peculiar series of bridges constitutes a protective measure that war conditions have evolved. The railroad is a narrow-gage line near Dixmude which is used for transporting supplies on low flat trucks by man-power. Owing to the liability to bombardment by airplanes, it was found necessary to provide shelters, for which reason these bridges were built at intervals as a protection for both men and cars. Compare with officer for height



This glorified meter index enables Cincinnati children to fathom the mysteries of gas and electric meters

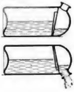
Teaching High School Pupils How to Read the Meters

THE indicators of gas and electric meters are no longer mysteries to pupils attending the Woodward High School in Cincinnati.

Pupils of the school have constructed large duplicates of the gas and electric meter dials. By the aid of strings attached to the mechanism of the dials, gas and electric consumption readings are indicated at the will of the teacher.

Safety Bottle in Which to Keep Poisons

"QUICK, a little medicine, sister fainted!" Many a night the cry ...own the whole ...old into confu... ...nd excitement. ...member of the ...rushes to the ...ine cupboard, ...the bottle stand... ...e place that had been reserved ...medicinal brandy ...es it to the sick... ...bottle seized ...ement of the moment does not contain brandy, but carbolic acid and only the timely discovery of the mistake can save the sick girl.



To pour liquid from this bottle it must be laid flat with the outlet pointing straight up.

The poison bottle invented by Lee Howdeshell and shown in the accompanying picture would greatly diminish the possibility of such fatal mistakes. The neck of the bottle is not at the top as in ordinary bottles, but at one side. Below the outlet is an arrangement of walls which makes it impossible to pour out even a small part of the liquid in the bottle without careful manipulation. The bottle must be inclined to fill the narrow space between the walls of the partition and then back, to allow the small quantity of liquid to drain into the upper compartment which communicates with the neck. In view of the attention required to extract the contents, it would be almost impossible not to notice what they were.

We Are Now Growing Our Own Camphor in Florida

THE first and only bearing camphor plantation of any size in this country is located at Satsuma, Fla. It contains over 2,000 acres of camphor trees which last year yielded over 10,000 pounds of crude camphor. This year it is expected that the yield will be many times this amount. Florida has several other plantations, which will soon come into bearing. Many more trees are being planted, and camphor may soon become profitable.

Sea-Gulls Betray the Presence of Submarine Raiders

EDWARD H. FORBUSH, the State Ornithologist of Massachusetts, advocates the protection of the sea gulls, because they are useful in detecting and betraying the presence of submarines. The gulls follow in the wake of submarines to pick up their refuse, and thus betray the presence of the U-boat to the watching aviators.

Anything to Attract Attention—The Masked Sign Girl

SINCE the suffragettes have paraded and walked the streets in small groups carrying flaring banners, no one ought to shrink from being the ham in a sign-sandwich. And yet we have some pre-suffragette conservatism left. We say so, because the shy Miss shown in the illustration hides her charms behind a black silk mask. But then (and we are assailed by a doubt) is the mask an attention-attracting device or a genuine mark of maidenly modesty? Upon this mystery the oracles are silent.

Why the masked face? Innate maidenly modesty? Or simply an attention-attracter?

© Underwood and Underwood

Statue of royalty in Odessa veiled but not destroyed—a good sign of level-headedness

Great Catherine Is Veiled But Not Destroyed by Revolutionists

IMPERIALISM and its autocratic rule have been dethroned in Russia and slowly, but surely, liberty and order evolve from political chaos by the leaders of the revolutionary factions. There are still a great many things to adjust and the completion of the task will require decades of hard work. It is not likely that the work of reconstruction will be accomplished altogether without friction, for, it must be borne in mind, there are still many persons in Russia who adhere to the imperialistic system of government.

It speaks well for the revolutionists of Russia that they have displayed, so far at least, remarkable moderation in their acts and have refrained from mere vandalism. Nowhere have they wantonly destroyed monuments or memorials commemorating the deeds of former Russian rulers. The picture, for instance, shows how considerately the revolutionists in Odessa treated the magnificent memorial to Catherine II. in their city. They did not injure it, but hid it from sight by wrapping the entire monument with heavy canvas. Acts like this prove that the Revolution is not at all the blood-mad orgy some people think.


© Western Newspaper Union

No, they're not fumigating an orchard. The puff of smoke is a target for artillery practise

Our Artillery Shoots at Curling Smoke for Practice

"SOMEWHERE in the United States" our artillerymen are practising. They have to have something to shoot at. Recently ingenious soldiers rigged up the apparatus shown in the accompanying illustration. It consists of a long pole at the end of which is a container for holding two ounces of black powder. This is ignited by pulling a string. A percussion cap is set off. The resulting puff of smoke simulates a bursting shrapnel closely. Somewhere in the distance are a line of artillerymen, who want to get the range. As the cloud of smoke bursts in the air, it represents within certain limits the entrenched position of the enemy. As he sees the smoke curl upward, the commanding officer gives his directions to the gunners. The gun crews immediately answer with dummy rounds of ammunition. As the bombs go off in different quarters and at different heights, they see to it that the guns are trained to bear on the point where the enemy fire originates, and not on the actual place where the cloud of smoke is observed. In this way they get accurate training, and more complete preparation for actual service "over there."

It's Beginning to Rain, So Bang! Goes the Window

AN automatic device which takes care of the windows of a house or apartment, and closes them when it begins to rain, has been perfected by L. M. Phelps of Philadelphia. It is quite automatic and its action is said to be positive. In his device a loop lever, connected with a stationary rod attached as a permanent fixture to the lower corner of the upper window sash, is held in position by a narrow strip of blotting paper. So long as the paper is dry it is rigid enough to hold the delicately adjusted lever, but a single drop of rain will so soften the paper that it allows the loop of the lever to fall and thus to release the pressure of the lever against the lower sash. Since the sash is weighted with a bag of sand or small shot, it will drop and close the window against the rain.

In addition to acting in case of rain it can be made to work at a predetermined time by alarm-clock.

Here is an automatic window-closer operated by a strip of blotting-paper

Introducing the Moropus

Nature mixed up a horse, a rhinoceros and a giraffe and obtained—a moropus

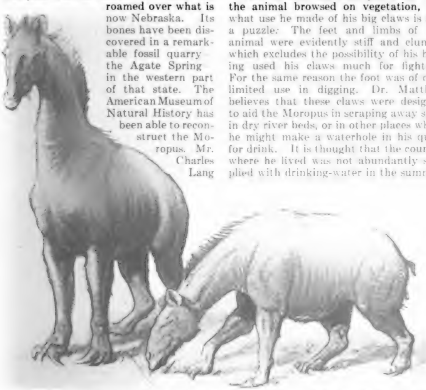
A CENTURY ago, Cuvier, the great French scientist, in laying down what is now known as his "Law of Correlation," stated that horns and hoofs distinguished only vegetarian animals. Claws belonged to flesh eaters, according to his law, and no animal which subsisted on a meat diet had hoofs.

This law of Cuvier's was accepted for decades. Recently the discovery of a remarkable fossil has disproved it. In prehistoric days there was a grazing animal which had powerful claws instead of hoofs.

This animal, which has been called the Moropus, was an American beast, that roamed over what is now Nebraska. Its bones have been discovered in a remarkable fossil quarry—the Agate Spring—in the western part of that state. The American Museum of Natural History has been able to reconstruct the Moropus. Mr. Charles Lang mounted the skeleton of the beast. A sketch of it as it appeared has been prepared by Mr. Erwin S. Christman who worked from directions given by Dr. Osborn and Dr. Matthew.

The animal is a strange combination of horse, rhinoceros, camel or giraffe, but it differs from them in having an enormous claw on each front foot and a smaller claw on each hind foot. The peculiarity of this possession lies in the fact that grazing animals do not require means of attack such as claws. They need their hoofs solely for moving about and not for attacking prey or for digging.

The teeth of the Moropus show that the animal browsed on vegetation, but what use he made of his big claws is still a puzzle. The feet and limbs of this animal were evidently stiff and clumsy, which excludes the possibility of his having used his claws much for fighting. For the same reason the foot was of only limited use in digging. Dr. Matthew believes that these claws were designed to aid the Moropus in scraping away sand in dry river beds, or in other places where he might make a waterhole in his quest for drink. It is thought that the country where he lived was not abundantly supplied with drinking-water in the summer.



One would imagine this animal to be called a "rhinocerhorse" or a "girafferos" or something like that, but his real name is Moropus and he lived at a time when the world was young

The Eyes in the Air

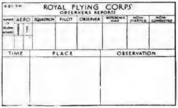
All aboard for a reconnaissance flight over the German lines

By Aviator Henry Bruno

Late Imperial Royal Flying Corps, Canada

IN the British Flying Corps there are two kinds of air reconnaissance work—Corps and Army. Corps reconnaissance is carried out by a single airplane and army reconnaissance by squadrons of machines numbering not less than five and as many as thirty. To understand just what a Corps reconnaissance flight means it will be necessary for me to transport you to an active section of the Western battlefront during the summer.

A two-gun, two-seater Sopwith fighter is trundled out of a hangar. While the pilot is inspecting the map of the territory over which he is to fly, the observer receives his orders to get information on the movement of enemy troops, motor transports, trains and the direction in which they are going, over an area of not more than ten thousand yards in front of the allied position. A duplicate of the pilot's map and writing materials are ready in the observer's seat.


ROYAL FLYING CORPS
OBSERVERS REPORTS

AERO	SQUADRON	PILOT	OBSERVER	REFERENCE MAP		

TIME	PLACE	OBSERVATION

When the observer returns from his trip over the enemy lines he fills out a report on a blank like this and turns it in to general headquarters

As the final order is given, the plane ascends and wings its way over the lines towards the enemy. The pilot climbs rapidly, keeping a wary eye open for enemy air-raiding squadrons. The usual height at which he operates is from six thousand to ten thousand feet.

Nearing the German lines the observer eagerly scans the ground below through powerful glasses. If you were to look through these same glasses you [illegible] mile after mile of shell-[illegible] every mile seemingly the [illegible] next. But to the [illegible] that ground [illegible] noting, in[illegible] give hi[illegible] over [illegible] be d[illegible]

[illegible]

means nothing; but the men in the plane know that it is a train winding towards the front. Its position is quickly marked on the map.

What's That Cloud of Dust?

A white road next occupies their attention. The pilot drops the plane a little—utterly oblivious to the anti-aircraft shells bursting around him. One part of the road is obscured by a black smudge and a cloud of dust. A regiment of infantry is on the march. Why infantry and not cavalry? The dust cloud tells. It would hang in the rear of cavalry and the men and horses would look like black specks. It is such deductive reasoning as this that an observer has to be trained to make.

The observer estimates the number of troops by figuring what space they occupy. A little further on, three black specks move rapidly down the road. Motor trucks in a hurry. All this is recorded by the watchful observer who becomes more keen as the minutes pass.

The plane is over a railroad station now. Are there any parked motors? How many cars are on the rails? Several working parties below run for cover when the plane hovers over them. Evidently this is an important depot as seven "archies" [illegible] skyward in an effort to scare [illegible]or away. A shell bursts [illegible]lane rocks from the ex[illegible] the pilot shuts off the [illegible] dashes earthward in a [illegible] is not hit. The ob[illegible] a closer view of the [illegible] and nearer the plane [illegible] machine-guns from the [illegible] to the din from the anti-[illegible]. Five hundred feet from [illegible] he flattens out, opens up the

Underwood and Herbert

Soldiers in One of the Winding Trenches of a Shell-Pitted Battlefield

Military information of the kind which this picture contains is carefully noted by the observer who engages in Corps reconnaissance. Considerable deductive power is necessary

motor, and is off again—homeward bound.

Again the battlelines come into view below, and the observer looks out for new trenches. Sure enough he sees several, and marks their position carefully on the map; also whether they are traverse or communication trenches. The condition of the barbed wire entanglements next engages his attention. Where they are

© Kadel and Herbert

Army reconnaissance observers study enemy airdromes, make a note of the number of hangars and planes on the ground and watch the movements in towns and large encampments

broken by shell fire he sees smudges and spots, all of which are faithfully recorded.

Camouflage or a Battery—Which?

The shells come thick and fast, but the pilot is an old hand at the game; he'll stick till the work is done. Cleverly hidden on the ground, the observer sees some small narrow-gage tracks, terminating in several pits. Has he discovered a new enemy battery, or is it camouflage? He must see the gun flashes before being sure. There they are! One! Two! Three! Four! Five! He also sees the blast marks in front of the battery. Now he is satisfied. Signalling the pilot he focusses his glasses again—this time in the direction of home.

A few minutes later, watchers at the R. F. C. airdrome see the reconnaissance plane winging its way back home, and shortly it settles safely to earth outside the hangar.

The observer fills out his report on a blank similar to the specimen shown on page 508 and turns it in to G. H. Q. (General Headquarters). The filing of this report marks the conclusion of the Corps reconnaissance.

Army reconnaissance squadrons carry cameras and take photographs at many different points. One of these squadrons will often fly several hundred miles into enemy territory in order to gain desired information. Instead of writing down single items as in Corps work, the observers report the general impression gained from the entire trip. The reason for this is that there are sure to be many movements which are not important, when a large territory is covered. Army reconnaissance observers study enemy airdromes, make a note of the number of hangars and planes on the ground and watch the movements in towns and large encampments. Rivers and canals are also looked for, particularly if there are any ships on them. The size and type of boat must be reported; also to which side it is nearer.

What the Observer Looks For in Army Reconnaissance

The railroads, highways, woods and towns are studied as in Corps reconnaissance, except that an especial look-out is kept for hostile kite-balloons, "blimps," and aircraft. Each squadron is escorted by scout machines whose duty it is to keep off attacking planes. The pilot of an Army reconnaissance plane must not give offensive battle to the enemy. The scouts are there for that. Should an enemy plane get through the formation, however, it is the observer's duty to see the enemy first and open fire. If he doesn't it probably means that his plane will "crash," and not only will he and his mate go down to death, but the records for which they risked so much will be destroyed.

Army reconnaissances are carried out at from one to twelve thousand feet, and strict orders are issued that there be no straggling. A favorite pastime of the Germans is to send three or more machines into the air to look for our stragglers. Perched high in the sky, generally about eighteen thousand feet, these hawks watch and wait. Suppose a fighting scout has motor trouble or wants to look around a little. He swings out of line and the others close in. Soon the squadron is almost out of sight, homeward bound with the precious reports. The scout flies along at about fourteen thousand feet. Then down from their perch swoop the Germans. The rat-tat-tat of their machine-guns warns the allied pilot of his peril. He may down one or possibly two of his antagonists, but in the end he crashes to earth the loser in an unequal fight. That is why R. F. C. orders read "Do not straggle; to do so means the loss of pilot and plane."

In Corps reconnaissance the pilot does not run such a risk, as he flies over a comparatively small territory and can generally dash for home if attacked. Of course he has to contend with anti-aircraft shells and the possibility of a surprise attack from the air; but for all that his lot is easier than that of other pilots who venture far into enemy territory.

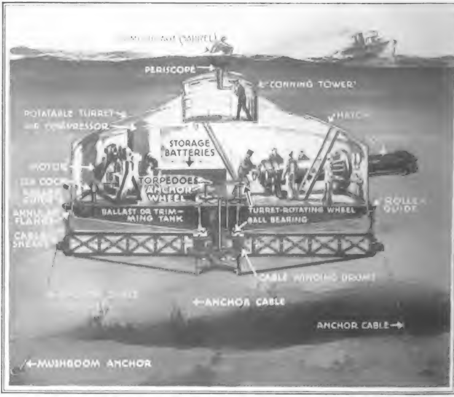
You will be astonished to learn that the average age of R. F. C. pilots doing reconnaissance work is twenty and of observers twenty-two. It requires young blood and muscle to stand the strain, risk and excitement of this branch of the air service. That results so far have more than justified expectations, is a tribute to the skill and bravery of these youngsters.

Food Animals Killed on One Railroad in a Year Would Feed 70,000 Soldiers

A PLACARD posted on the premises of a certain railroad which runs through the Cotton Belt states that during the twelve months ending June, 1917, 2,792 head of cattle, horses and sheep were killed by the trains. This is the equivalent of one million pounds of food, and would be sufficient to feed seventy thousand soldiers for thirty days. This line operates only 1,809 miles of track, and that lies in the cotton country, where food animals are not produced to any large extent. What the returns would be for such states as Missouri, Iowa, Illinois, or Kansas one can only surmise.

Submersible Forts to Protect Our Coast

They are conceived as anchored, floating turrets, capable of discharging torpedoes at the enemy's ships



The turret-shaped submersible fort can be rotated upon a substructure anchored by means of four mushroom anchors. Its only armament is represented by a single torpedo tube

It is a short time before sunrise. The sea is fairly calm and reflects in undulating patches the gorgeous colors of the sky already visible in the East. The rhythmic sound of a whirling propeller is faintly audible. It is still far away, but approaching rapidly.

Fifteen minutes later the graceful yet forbidding form of a warship emerges from the light morning mist. It is an enemy raider headed for the roadway to one of America's important Atlantic ports.

On board the hostile ship the tension is great. There may be mines and submarines, coast batteries and other defences. The deck watches have seen nothing suspicious and cautiously the raider continues its way toward the roadway.

The hostile craft has just passed a few hundred yards from a piece of wreckage, a waterlogged barrel, when the watcher notices a sharply defined line of bubbles rapidly approaching the ship.

"Torpedo coming, look out!" he yells with all his might. It is too late. Before the course of the ship can be changed the torpedo strikes amidships. A tremendous explosion makes the water rise like a

fountain and descend again upon the shattered and fast sinking hull of the ship. A few moments later all is over.

The torpedo, which was launched from the tube of a submersible anchored fort, the periscope of which was camouflaged by the barrel, has done its work.

An episode like that pictured here, in brief, would be entirely within the range of possibility, should the government adopt the idea of a submersible fort in accordance with the invention by J. A. Steinmetz of Philadelphia, recently patented. The fort, in the form of a turret, provided with a conning tower, may be submerged altogether or only so far that the conning tower is visible. It is the plan of the inventor to anchor such forts along the coast and near harbor entrances as a protection against hostile ships. The mechanism for winding and unwinding the anchor cables, for turning the turret upon the ball-bearings of its anchored base and for launching the torpedoes is controlled from inside the turret and storage batteries supply power for the airpumps, and for lighting the crew's quarters. For cases of emergency a supply of compressed air is stored in a pressure tank in the turret. The forts would be self-contained and would carry sufficient supplies to enable them to carry on between the periodical visits of a supply ship.

Italian War Dogs Are Well Cared For and Well Trained

DOGS, at least some dogs, have proved themselves so valuable for military purposes during the present war, that they have been added to the equipment of every army engaged in the struggle. The main purpose for which they are used is the finding of wounded soldiers after an engagement or skirmish in difficult territory, so that they may be carried to the field hospitals immediately behind the lines without delay. The dogs employed for that purpose are carefully trained and well taken care of, as their usefulness depends in a large measure upon their good physical condition and their willingness to work.

© Underwood and Underwood

Two interesting pictures of "dogs of war." They are used for finding wounded men

Various breeds of dogs have been tried by the governments of the belligerent nations, but only a few of them have been found of value. The dogs shown in the pictures are used by the Italian army in its difficult campaign in the mountains. They are of several different breeds, with the St. Bernard type predominating. St. Bernard dogs have been used in relief work in the high Alps for centuries and have proved themselves hardy, efficient and trustworthy even when working by themselves. The sagacity and courage of the St. Bernards are wonderful. They seem, at times, almost human.

Those of us interested in science, engineering, invention form a kind of guild. We should help one another. The editor of the POPULAR SCIENCE MONTHLY is willing to answer questions.

Hiding Ships with Paint

How protective coloring causes Fritz much waste of torpedoes. It is camouflage at its best

By Robert G. Skerrett

THE gun afloat, whether upon a naval craft or an armed merchantman, drives the submarine to cover beneath the waves when it approaches its prey close enough to discharge the torpedo. The U-boat commander must, therefore, keep track of his moving target. At best, a periscope is a poor substitute for the naked eye or the binocular vision made possible by good field glasses. The periscope is one-eyed, and this entails very definite and unsatisfactory limitations. These facts must be kept in mind in order to evaluate the real purpose of marine camouflage.

Marine camouflage differs radically from camouflage ashore where the character of the background facilitates concealment. It is a simple thing to cloak a gun with a screen of foliage or to mottle it with paint so that its contours disappear. The ship afloat, except through the agency of a smoke screen, cannot veil its identity. Under certain conditions of light, the vessel stands vividly silhouetted against the sky, and even when the atmospheric contrast is not so sharp, the ship can be seen rather distinctly though painted a single tone of gray.

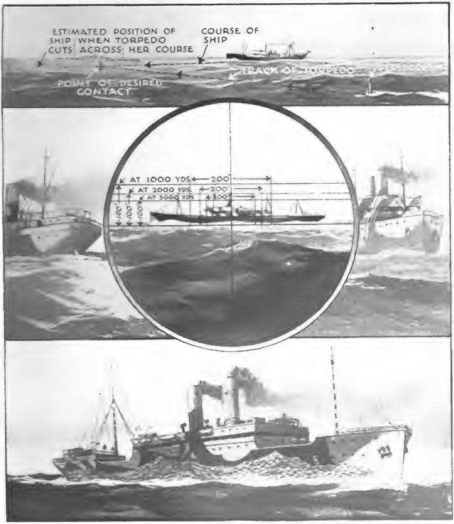
Atmospheric gray and paint-brush gray are two fundamentally different things so far as vision or visibility is concerned. The latter is the product principally of black and white pigments, while the atmospheric gray is a vibratory effect resulting from the movement of red, green, and violet rays of light. The quality of this gray alters from hour to hour as one or the other of these chromatic rays predominates, and, manifestly, no single pigmentary gray could accommodate itself to these changes. Finally, the character of a ship is indicated by her body form and her upper works—details that are emphasized by high lights and strongly contrasting shadows.

The submarine in the barred zones seeks to close in upon its quarry during the dusk of early morning, or the close of day or after nightfall, especially if the moon helps to make the enemy craft discernible. The camoufleur therefore tries to reduce the visibility of vessels during the periods of dim or half light, and, curiously enough, the more scientific of these men employ really vivid coloring for the purpose. They paint their ships with apparently meaningless splotches of strong pink, blue, and green. The patches become prominent agreeably to the predominating light ray at the time, and serve to obliterate those familiar details or forms for which the observer looks. Not only that, but normally shaded areas are purposely painted light, and the visual effect is flat and confusing. There is dazzle and loss of definition in fairly strong light, and, during periods of twilight, atmospheric vibration induces a gray tone that is so nearly akin to the sea background that craft painted in this marked fashion actually become invisible at a mile!

Upon the field of a periscope there are a number of horizontal lines as well as vertical ones. The horizontal lines are spaced to represent a prescribed height at distances say of 1,000, 2,000, or 3,000 yards, while the vertical lines are spaced to indicate definite intervals at those different distances so as to determine the speed of a vessel passing across them. The U-boat commander, in order to launch his torpedo with a fair chance of hitting his target, must know how far off the enemy ship is, whether her course is bringing her closer or taking her away, and approximately how fast she is moving. With these factors fairly gaged, the torpedo is pointed far enough ahead of the target to allow for its time of flight and the advance of the enemy craft.

The commander of the submarine must also be able to measure the height of his quarry from her true waterline to the top of her smokestack, which is a reasonably

Mimicry on the High Seas



Camouflage at Sea

The first illustration shows how closely related the problems of a submarine commander are to those of a duck hunter. He must estimate the speed and course of his target and shoot enough ahead to allow for them. The centre picture shows the appearance of a ship at 2,000 yards, seen through the periscope of a submarine under ideal conditions. The range is determined by the height of the smokestack above the waterline. The two side illustrations are examples of the way the camoufleur changes the light and shade on the hulls, funnels, etc., of vessels, thereby confusing an observer both as to the length of the ship and the angle of her approach or departure. The ordinarily high lights are toned down, and the naturally dull portions are thrown up by painting them in bright colors. At the bottom is seen a complete camouflaged boat, and one that was painted by a master-hand. The whole idea is to give the impression of a sinking ship, and to merge the ship proper into the background. It will be noticed that the dark shaded patches on the hull would convey, at a distance, the impression of a funnel and waterlogged hull, while the sham "sea" merges into the real sea and makes it appear that the alleged steamer is in a sinking condition. This particular instance is a most ingenious one. A more common one is to paint the hull of a smaller vessel of radically different dimensions on the hull of the boat, or to "paint off" the stern and raise up the apparent waterline.

constant figure in the run of commercial freighters, and may be pretty accurately estimated in the cases of other larger merchant ships or well-known types of naval vessels. Any coloring that will tend to obliterate the actual waterline or conceal or confuse the top of a steamer's smokestack will deceive the observer in his effort to determine the distance or range of his target, and, therefore, throw him out in calculating how far his torpedo must travel in order to score. Also, any coloring that destroys the outlines of the ship and makes it hard to observe her movement across the periscope's vertical lines so as to estimate her speed, will introduce another element of error.

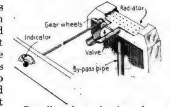
It has been determined by careful investigation that the eye tires in the course of a minute or two when watching a moving target steadily through a periscope even in broad daylight; and the eye so fatigued becomes erratic in judging both range and speed. It should be evident, then, that marine camouflage as we have developed it in this country is calculated to hasten visual fatigue and to so bewilder the U-boat commander, when he can see one of our vessels, that his torpedoes will be likely to go wide of their mark. We may change the old adage "To err is human, to forgive divine" to "To err is human to increase the error is angelic" in this case.

Save Gasoline With This Device for Controlling Engine Temperature

GASOLINE is not what it was five years ago. It is becoming heavier, so that it is more and more important to control engine temperatures automatically. Otherwise the fuel will not be properly vaporized and gasoline will condense in the manifolds and cylinders and destroy the greasing properties of the lubricating oil. The by-pass arrangement shown in the accompanying sketches is a simple way of controlling the temperature.

An arrangement that makes sure of the vaporization of the heavier gasoline of these days

Inside of the radiator at the rear is a separate vertical pipe. This pipe enters the lower radiator tank at the bottom. An elbow at the top of the pipe has a plain shutter valve which can be opened or closed so that the water returning from the engine can be sent to either the vertical pipe or to the top tank of the radiator. The operation of the valve is controlled by the car driver by means of a rod and two meshing gears so that in cold weather only a portion of the cooling water may be sent through the radiator or all of it through in hot weather when additional cooling is required.



Details of mechanism for actuating the valve from dash

This little improvement will add greatly to the starting-up capabilities of the car, particularly in cold weather, as the gasoline is always easily vaporized.

The Tick Was the First Insect Disease-Carrier to be Caught

ARSENIC treatment and starvation are gradually destroying the fever-tick which has been such a cattle-pest in the southern states.

The tick, however, has served a useful purpose. When the Bureau of Animal Industry, of the Department of Agriculture, discovered that this little insect carried disease germs from one animal to another, it was the first step which led to our preventive sanitation, which is putting an end to mosquitoes, house flies, rat-fleas and other disease-carrying parasitic insects.

Wrapping Taffy by Machine at the Summer Resorts

HOW many times at the beaches or other summer resorts have you seen girls, and even men, wrapping the famous salt water taffy, kisses, chocolates and other candies? But times have changed, and munitions are more important than candies. Our manpower and woman-power must be conserved. The mechanical candy wrapper shown in the accompanying illustration offers one method of conserving our resources in this direction. It is electrically driven and consists of a small vertical stand having a cylindrical drum at its center, in which is placed a small toothed gear device which moves up and down and wraps the waxed paper around the pieces of candy. At each upward movement, the paper is inserted between two adjacent pieces of candy, and on the downward movement one piece is wrapped up and the ends twisted as shown. The attendant has only to feed the machine, which will wrap as many as one hundred pieces a minute. The use of the machine also saves much of the handling.

This little machine wraps candy more quickly than you can count the output

© Underwood and Underwood

A unique memorial belonging to the Elks. It is a great bronze book five feet high

Chicago Elks Install a Bronze Memorial Book

THE magnificent bronze memorial book shown in the picture was recently completed by Mr. Robert C. Lafferty for the Chicago Lodge of Elks, No. 4. It stands five feet high and the fourteen pages of it will give space for twenty-one hundred names. The leaves can be taken out and placed in a vault.

Formerly the custom prevailed of erecting tablets and slabs to commemorate events and persons of importance. This proved too cumbersome and will now be superseded by the memorial book shown in our picture.

Dropping Death from the Skies

The bomb dropper and his murderous winged weapons which deal quick and ghastly death

By Carl Dienstbach

Photos © Kadel and Herbert

HARDLY had the airplane been adopted as a military weapon some four years before the outbreak of the great European war, when the possibilities of bomb dropping began to be considered. To the general public at least, it seemed easy to wipe out a fort, to demolish a bridge, or to blow up a battleship by the simple expedient of dropping on it a hundred pounds of high explosive. Engineers knew better. Long before the first Zeppelin flew over London, it was pointed out that it was hard to hit a target on the ground from an elevated platform moving at fifty miles an hour and more, because allowances had to be made for deflecting winds for the horizontal motion acquired by the bomb from the airplane. To hit a target the plane's height and speed over ground had to be known with almost impossible accuracy, and even if known, an infinitesimal hesitation in releasing the bomb would spoil the aim. A truly super-human sense of time was demanded. The difficulty, only vastly exaggerated, is the same as that which a hunter experiences in hitting running or flying game by aiming ahead of the target. Whether the target moves swiftly or the gun and the missile have a fast motion of their own, aiming ahead causes all the trouble.

On the whole, the public has been more far-seeing than military engineers. It reckoned with moral effects in its own unreasoning way rather than with physical principles. Bomb-dropping has become an indispensable mode of attack. The civilians of all the warring powers protest against it in vain. Germans denounce the "baby killing" tactics of the Allied aviators as hotly as England denounces the German slaughter of defenseless woman and children. Whether or not fortified places are bombed, civilians invariably suffer. A dozen bombs may be aimed at a munitions factory. One, perhaps, finds its mark. The rest are scattered over a residential quarter with an effect too ghastly to be described. Aim at a powder mill and you hit a hospital.


Modern "fletched" airplane bomb. Note streamline form, size, and weight, as shown

As the war progressed, bombing became more accurate, although the misses still far outnumbered the hits. The reason for this increased accuracy is revealed in the truly remarkable photographs of French bombs which we publish herewith and which have been permitted to reach this country by a lenient censor.

The bombs pictured have been called "aerial torpedoes." They do bear an outward resemblance to the naval torpedo. For all that, the designation is incorrect. The internal construction bears little resemblance to that of a naval torpedo. The bomb shown is provided

A wonderful photograph taken from a French airplane while bombing a German factory in Lorraine. Seven bombs may be seen in the air, all released together by the same machine

with tail planes to make it fly straight—a tail which has the same effect on the bomb as the tail feathers have on an arrow. In addition there is a "propeller" to sensitize the percussion fuse during the bomb's fall.

Particular attention is directed to the extraordinary photograph which shows seven bombs flying through the air after having been released nearly simultaneously. They do not drop. They literally rush through the air like naval torpedoes, thereby to a certain extent justifying their alias. Released from a machine which is traveling at a speed of ninety miles an hour, they necessarily have, for a time, the forward motion of that machine and actually travel horizontally. Realizing all this, their designers gave them an ideal streamline form. In the picture only the lowest bombs have begun to turn downward

visibly and to drop vertically. The uppermost one is seen gliding like an airplane itself in spite of its great weight, in spite of its comparatively small surface and in spite of the fact that it has only a belly in place of wings. The moment bombs drop from their tubes (one-third as slowly as they are swept ahead by the plane) they are swung by momentum and air pressure on their tail planes into a nearly horizontal position. In that position their shape encounters practically no resistance from ahead but a great resistance in the direction of gravity, not only because in trying to fall they must cleave the air with their big broad sides, but chiefly because in dropping they are now opposed by the inertia of the air encountered in falling, and, in addition, the much greater amount of air encountered in moving ahead. As long as momentum continues, falling is greatly retarded, and, with practically no head resistance, it is bound to continue indefinitely. But as soon as actual falling begins, the head dips a little, aided by the tail planes. In this position the fall itself will preserve and increase the horizontal speed, just as in coasting down hill in a sleigh. If the total surface of a correctly designed bomb were not so extremely small in proportion to its weight, it would seemingly never reach the ground.

Balloonists sometimes threw empty bottles from their baskets. They marvelled at the crazy antics performed by the bottles and the long time they took in reaching the ground. It was the approximation of streamline form that delayed the bottles.

Slipping a bomb into an airplane. The tail is being inserted smoothly into the discharge tube

Bombing is like torpedoing. Bombs have assumed the shape of torpedoes not to prolong their fall, a thing in itself rather unfavorable, but because the lower winds have practically no influence over a torpedo. Guided by its tail, the torpedo-shaped bomb simply turns its sharp nose against the wind and cleaves it without deflection.

That is why bomb-dropping is more accurate than it was at the outbreak of the war. Moreover, bombs are dropped on the shotgun or blunderbuss principle. In other words, they are released a half a dozen or more at a time. One at least will find its mark. By releasing bombs in quick succession, errors in judging altitude and speed are readily corrected, because the bombs scatter principally along a line parallel with the path of the machine.

Are You Afraid to Look at Yourself in a Mirror?

Dr. Martiri has recently found that certain patients are afraid of mirrors, —a result of watching the change in appearance as emaciation progresses. When a dyspeptic is cured his horror of looking in a mirror persists. This is called cattotrophobia.

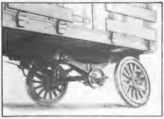
A Bazooka Is a Musical Wimwam

Yankee Doodle came to town playing the Bazooka

THINGS are not what they seem. This observation of Longfellow's is borne out by the mysterious looking instrument in the hands of the soldier boy in our picture. It may look to you like a cross between a plumber's sign and an opium pipe or almost anything else, but it isn't. You will learn the truth the next time you visit a cantonment. You will learn that this queer-looking object is a musical instrument christened the "Bazooka." How does it sound? Just as it looks. If you know anything about plumbing or steam-fitting you will at least admire the bazooka as a good piece of pipe-fitting. The rookies are exceedingly proud of this weird noise-producer.

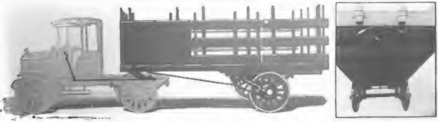
Even in Turning a Corner the Brakes on the Rear Wheel Take Hold

IF you have miraculously escaped injury in a skidding automobile on a slippery pavement, you can readily understand why the rear wheels of a motor truck semi-trailer should have been provided long ago with some form of brakes controlled from the driver's seat. In fact it is quite as necessary to have brakes on the rear wheels of a semi-trailer as on an automobile, for the reason that the greatest portion of the trailer load is generally carried on the rear wheels. This causes them to swerve around very easily when the brakes are applied to the driving wheels of the tractor.



One of the greatest difficulties in the development of such brakes has been the weaving and twisting strains set up between the tractor and the trailer and the necessity of making the brakes hold when the trailer swings around at an angle to the tractor centerline as in turning corners.

This difficulty has been overcome in the new type of brakes, shown in the accompanying illustrations, by mounting the front end of the brake rod in a universal joint at the center of the fifth-wheel, which supports the front end of the trailer body on the tractor platform. As a result, the brakes, which are of the conventional motor-truck type, are always operative, whether the trailer is moving up and down, as when running over rough roads, or when turned, as in rounding corners. The brakes are set and released by an ordinary brake-handle operated from the driver's cab.



The illustration shows regular motor-truck brakes applied to a semi-trailer and operated through a universal joint so that they may be used on corners and turns

Simple Inventions to Make Housekeeping Easy

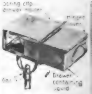
Bath spray hose kinked on nail and new hanger that prevents it

A cabinet dumb-waiter that rises with the pressure of the foot on the floor

Curbs, stairs and other obstructions that usually jolt the baby badly are all smoothed out by this new glide go-cart

A handsome tea ball set made either singly, in pairs, or sets of four or six

A stout wire clip to prevent a key turning in the lock of a door



A gas tip frame to hold a square cup over a gas jet for heating

An extension clothes-prop that holds the line at any height that may be desired

A convenient tea outfit in a small case for the traveler

A sanitary stone churn mounted on a wood base. The churn is easily cleaned and has great lasting qualities

A canvas covered playhouse for the children with screen netting side walls

A convenient nursing bottle holder attached to the side of a baby carriage

Parts of a knockdown chair, showing how it is put together upon arrival at purchaser's

A slip-on table top cover which is used by movers to prevent scratching a finely finished surface in the handling. Strings are run through a hem at the edge which draws the edges together when it is in place on the top

An extra opening in the tea-kettle top to pour water into, preventing the scalding of a hand

King Weather Rules the War

In spite of all improvements in military art, the elements are absolutely supreme

Lying down on the job. He believes "too much is enough"

LAST October a fleet of thirteen Zeppelins left Germany for an air raid over England. These huge and relatively slow craft are at the mercy of the winds to a much greater degree than the small, swift airplanes, and their sailings are nearly always timed by the meteorological conditions present and prospective. Germany has able weather forecasters, but they are hampered in their work by the fact that the war has cut off their reports from western Europe and the Atlantic—the regions from which come storms and weather changes. Apparently there was a serious miscalculation in connection with the raid of Oct. 19 20, for when the airships turned homeward they had to face strong northeast winds, while dense fogs below blotted out the landmarks. At least four of them drifted far out of their route and were brought down in France; one, the L-49, intact. A fifth is believed to have foundered in the Mediterranean. The crew of the L-49 suffered severely with the cold, the thermometer falling to 36 degrees below zero when they were at the greatest altitude. One man's hand was so badly frozen that it had to be amputated. So much for weather.

In the air, on land and on sea, the weather is playing a capital rôle in the present world conflict. Always a prominent factor in warfare and often a decisive one, it has assumed greater importance than ever before, on account of the addition of aircraft to the world's armaments; the use of asphyxiating gases, borne by the winds; the effects of extreme heat and cold upon the operation of internal-combustion motors; the relation of rainfall and the freezing of the soil to the construction and maintenance of a vast system of trenches; and, indeed, in a host of ways that entered hardly, if at all, into the calculations of military experts a few short years ago.

"Mud Is the Greatest Enemy of the British Army"

Beginning with its predominant influence upon the crops, and hence upon the food supply of the warring nations, one could fill pages with an enumeration of the effects exercised by the weather upon the progress of the struggle. The newspaper reports from the battle zones abound with such episodes as the hampering of operations by heavy rain, the obstacles or advantages offered by fog, the miseries inflicted upon troops by heat and cold, the freezing and thawing of rivers and marshes, the ice blockades of northern harbors, the obstruction of mountain roads with snow, and the atmospheric vicissitudes experienced by aviators.

Veterans of the American Civil War, who thought they knew something about mud, must now take lessons on the subject from the men who are fighting in western Europe. "Mud," says Lieut. G. B. Mackie, "is the greatest enemy the British army has had to face in France, and the only one it feared." The mud of northern France and Flanders will spatter the pages of every history of the war. In the vivid world pictures of Henri Barbusse, mud is the thing that makes the most durable impression. Nobody who has read "Le Feu" can ever forget one

night of drenching misery and the following dawn, when the place where the trenches had been was turned into a sea of mud, with the sentries mired, engulfed and drowned at their posts.

History is repeating itself, but on a vastly enlarged scale. General January and General February have fought for Russia against Germany, just as they once fought against Napoleon. Taking into account its effects upon the civil populations, cold weather has caused more suffering and loss of life in the present war than in a dozen previous wars. In the Mesopotamian campaign the British forces suffered terribly with the heat. Marches were made when the thermometer stood at 110 degrees and over. "We cannot carry enough water," wrote an officer of the Royal Field Artillery, "and one's tongue soon swells when the sun is up." The temperature in the hospital tents was reported as 130 degrees. Imagine the joy (?) with which these same soldiers received from home a consignment of "bullet-proof" vests, consisting of several inches thickness of a heavily woven woolly material!

They Licked the Moisture on Water Bags—It Was So Hot

Ignorance of climatic conditions has been responsible for many serious blunders during the war. The failure of the British campaign at the Dardanelles was partly due to the fact that the extreme dryness of the country was not realized and totally inadequate provision was made for water supply. Water had to be transported long distances on mule-back. When the mules carrying the water-bags reached the troops "the men would rush up to them in crowds just to lick the moisture that exuded through the canvas." In the hottest weather of August the soldiers were reduced to a pint of water a day. Eventually an immense reservoir, with distributing pipes, was built in the Anzac region. In the same region during the following winter, troops from northern Australia, who had never before seen a snowstorm, were treated to severe blizzards, which caused much suffering and illness, as neither clothing nor shelter were appropriate for such weather.

Similar blunders have occurred in every war. The horrors of Napoleon's retreat from Moscow furnish a monumental example of what results from ignoring climate. In the year 1719, a Swedish army under General Arnfeldt was almost annihilated by cold weather on the mountainous frontier of Norway and Sweden. Heavy rainfall and resulting floods led

© Underwood and Underwood

Mud, mud, mud! Rivers of it—seas of it. The horses are up to their middles and a truck lies mired up ahead. Yet shells reach guns and the Allied advance is as relentless as Fate

to the total destruction of three Roman legions, under Varus, in A.D. 9.

A Frozen Fleet Captured by Cavalry

Weather and climate are so important in warfare that a commander should always be prepared to guard against their adverse influences and to take advantage of those that are favorable. The mere effect of the weather upon the spirits of the troops may be a factor of success or failure. The character of an extensive "terrain" is sometimes completely changed in a few hours by the weather. Thus, impassable lakes and swamps may be turned into firm ice overnight—or *vice versa.* One of the most picturesque episodes in military history was the capture of a fleet of Dutch men-of-war by French cavalry in the year 1795. The vessels were frozen into the Zuyder Zee. A force of hussars under Gen. Devoynter, having wrapped their horses' hoofs in tow, crossed the ice and forced the whole fleet to surrender. During the Russo-Japanese war Russians made good use of a temporary tramway constructed over the ice of Lake Baikal.

© Press Illus. Serv.

Sometimes it is snow. Still more trouble. This railroad picture was taken on the West-Galician front

In view of all these facts it is really amazing that military authorities have been so slow in recognizing the strategic and tactical value of weather science and the art of weather prediction. The present war is the first one in which meteorology has been called upon to play any particularly definite part.

There is an interesting historical connection between weather forecasting and the art of warfare.

In the month of November, 1854, a tremendous gale shattered the camp of the Allied armies fighting against Russia in the Crimea, and sank the French warship *Henri IV*, lying off Sebastopol. The famous French astronomer Le Verrier made a careful study of this storm. By collecting the weather records kept in various parts of Europe he was able to trace its course—to show how it had swept in from the Atlantic and moved at a deliberate pace across the continent. He reached the conclusion that, by means of telegraphic reports, it would have been an easy matter to keep tab on the storm's progress and to give timely warning of its approach to the fleet and the army. This was the germ of the idea now embodied in the telegraphic weather services maintained by all civilized countries. Le Verrier submitted his plans to Napoleon III., and they were soon put in operation. Hence the Crimean storm of 1854 is a landmark in the history of practical meteorology, and weather forecasting received its first great impetus from the exigencies of war.

Making a Soldier of the Weather Man

To-day meteorologists are paying their debt to Mars. At the very beginning of the present struggle the German army put into the field a well organized weather service. Practiced forecasters were attached to headquarters; posts for making weather observations were established on automobiles; kites and balloons were sent up to test the air currents for the information of aviators and the artillery. In Belgium the Germans promptly took possession of the Royal Observatory, near Brussels, and made it a center for their meteorological organization. Before the war a German observatory had been established in far-away Spitzbergen, at the suggestion of Count Zeppelin, and

© Int. Film Serv.

In one awful hole! He didn't see it at all. He just put his foot down and squish!—he walked **on nothing. It is quite impossible to tell when the ground will give way and a horse vanish**

the reports from this institution proved extremely valuable to the Kaiser's forecasters, until the British government discovered the fact and sent a man-of-war to put this Arctic outpost out of business.

It is humiliating to confess that the *Entente* countries were much slower in mobilizing their weather men, but they are now making up for lost time, and all of them have efficient military meteorological services, supplementing the weather bureaus of peace times. In the British Army there are meteorological units attached to the Royal Engineers. The Italians have established a dense network of weather stations along their battle front. Our own army has a strong meteorological section, under the Signal Corps, officered by experts of the United States Weather Bureau.

For such undertakings there is only one precedent, and it is pleasant to record that the United States Government was the pioneer. During the Spanish-American War our Weather Bureau established a chain of observation stations around the Caribbean Sea, cabled reports from which were the means of protecting the American fleet from unpleasant surprises in the shape of West India hurricanes.

However, all the weather forecasters in the world will not be able to nullify the consequences of cutting the Belgian dykes, and so there will probably be mud, and mud, and mud, to the end of the war—and, likely enough, after that! So let the final word of this muddy article be—MUD!

A Salesman Who Talks to Himself Instead of to You

"YOUR money back, ladies, if this furniture polish is not exactly as I claim it to be.

"That's what I said—your money cheerfully refunded if you fail to find this polish the greatest labor-saving—"

"Look here, mister—you sold me a bottle of that polish last week and I am not at all pleased with it."

"Did you purchase your bottle from me, madam?"

"You know you sold it to me—why—"

"Oh—yes! I recall it now—How—"

Every shopper in the immediate vicinity is by this time attracted to the scene by the controversy.

"Did you follow the directions carefully, lady?"

"I didn't read the directions."

"Well—how can you expect results—"

"Yes. I admit I may have used the polish the wrong way. Do you mind showing me how you—"

"Certainly—to be sure—no trouble at all."

With a few rapid applications of the polish, the demonstrator converts the surface of a badly stained piece of mahogany into a bright, glossy, object.

During the entire performance no one succeeded in locating the sweet-voiced complainant. The fact is both voices came from the demonstrator who is a ventriloquist.

© Press Illustrating Service

A captive sausage balloon is provided with auxiliary air-bags which serve to steady the balloon. In the latest form these give the structure the appearance of a huge elephant

Now Appears the Elephant of the Air

The reason for the queer shapes of captive balloons

GUY FAWKES' Day in England is a holiday which remotely resembles our Fourth of July—a day celebrated to mark the thwarting of a conspiracy. It was the custom to send up on Guy Fawkes' Day balloons which were effigies of the conspirators. There were also balloons, sent up at county fairs, shaped like pigs and cows.

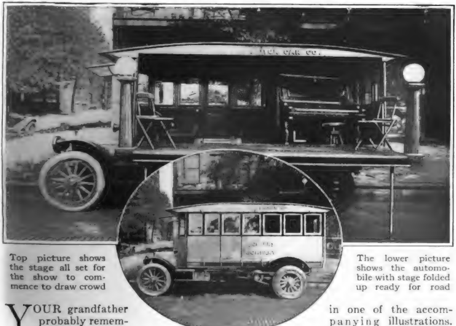
And now comes the French army with its elephant balloon, which is not invented for edification, but an earnest effort to improve the observation balloon.

It was the Germans who invented the "sausage" captive balloon which is raised by the wind after the fashion of a kite. Some countries adopted the sausage balloon and even bought the German manufactured product. Others, like France and Great Britain, obstinately clung to the obsolete spherical balloon. Then came the Great War and prejudice was blown away. The sausage was imitated at once.

A sausage balloon needs various appendages to catch the air and to steady it.

Using Minstrels to Sell Automobiles

This is where the oldtime patent medicine quack is completely outquacked



Top picture shows the stage all set for the show to commence to draw crowd

The lower picture shows the automobile with stage folded up ready for road

YOUR grandfather probably remembers the traveling patent-medicine "doctor" and his concert wagon. The "doctor" and his artists would locate themselves at some strategic point and after a few songs and perhaps a buck-and-wing dance, would draw a crowd of several hundred people to view the free show. A vivid burst of oratory, a glowing picture of what Ox-heart Pills would accomplish, a scramble to buy the precious medicine and the doctor would move on. He combined some of the delights of Coney Island with those of the modern corner drug store.

Although the traveling patent-medicine doctor has almost passed away, his principles have recently been applied by an enterprising automobile dealer in the Middle West to sell a particular high-priced car with a silent type of engine to small dealers in rural towns. He fitted one of the cars he sold with a body in which he stowed a piano as shown in one of the accompanying illustrations. The entire side swings down as a platform on which the singer shrieks *"Over the-e-re, Over the-e-re!"* And now a demonstrator takes the place of the singer. He is not so seductive as he is forceful and convincing. Listen to him:

"Ladies and Gentlemen! You have heard the singer and you have heard the piano. Not a word escaped you. And yet all the while the engine of this car was running. There was no rattling of valve-tappets. There was no roaring exhaust. There was no jingling of loose parts. That's the chief merit of this car—silence. It has an engine which is as noiseless as a cat and as powerful as fifty horses. Step up and get a catalogue."

One hundred and twenty-five cars were sold on one concert tour alone, and others were disposed of later through small-town dealers whose custom was secured as a result of the trip.

Our Annual Coal Drama

Each winter we have a coal shortage. What causes the trouble? Can we cure it?

By Lloyd E. Darling

In the March number Popular Science Monthly discussed the taking over of the railroads by the Government, and the probable effect of the action on the coal situation. This article deals particularly with the coal shortage itself, its causes and effects.—Editor

Actors in Our Annual Coal Drama—Part I.

These are the actors who go across our stage each winter. Many figures you will doubtlessly recognize. Up in the corner the sturdy miner goeth to work. Sometimes he comes back injured. Likewise do the many trainmen and others who have to do with the carrying of the coal to the consumer. They have been especially battered up this winter. These are typefied by the lower figure. In the center, the coal operator himself. He may be plump and prosperous as shown, or wan and lean, depending on how business goes. Beside him is one of his trusty business-getters. And beyond them are our railroads, harassed, and upset by such devils as congestion, car-shortage and freezing weather

Long hauls, ancient, discriminatory, and outgrown rates—also distributing plans—are the devils that wreck our transportation system. Here they are doing their customary good job

WE'VE had a coal shortage this winter—a severe coal shortage. Railroads have been tied up, people have suffered, legal holidays have been declared, troubles of all kinds have developed. Certainly all our troubles are not due to the war alone. We have had coal shortages before, and no wars to bother us.

How do we get ourselves into such a predicament every winter? Who or what is to blame? Is there a way out?

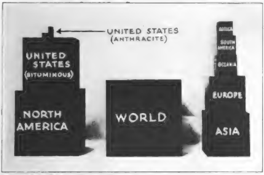
On the opposite page we present a diagram recently prepared by Chester C. Gilbert, Curator of Mineral Technology, United States National Museum. It indicates comparative coal supplies of all regions in the world. This diagram demonstrates one point: No matter how many "coal-shortages" we have now, or will have in the future, they are not and cannot be due to a lack of coal in the ground.

Geologists estimate that the Nation has between four and five trillion tons of coal within its boundaries yet unmined. What then is the reason it is so hard to get coal into a man's bins? Diamonds have hardly been more "scarce" than has coal.

The map on page 535 is interesting. It shows the hard and the soft-coal areas of this country. If you are a householder, what kind of coal was it you used this winter? Was it hard coal; or Pocahontas, perhaps? If hard coal, look where it had to come from! Way up in eastern Pennsylvania. If Pocahontas, it was

mined in the West Virginia region. If you live in Nebraska, or North Dakota, or still farther away, this map brings home to you the long distance that coal had to come.

If you are a manufacturer, how many hundred miles has your coal traveled this winter? Manufacturers around Chicago demand coal from southern Illinois and from West Virginia. Closer at hand is a plentiful supply. Likewise Iowa will not have Iowa coal, if it can help it. Those in the mountain regions of the West are none too well satisfied with their own supply. In the East, they're such connoisseurs that only the choicest fuel beds are touched. The railroads are cluttered with the crossing and recrossing of coal trains from all these conflicting sources of supply. Smith wants coal from Jones' region; Jones must have it from Smith's. Woe results.

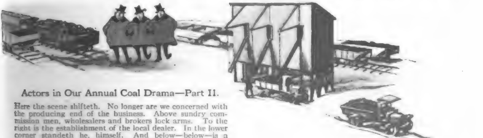


Courtesy United States National Museum

Comparative coal supplies of all regions in the world. Nick in the small cube shows hard coal we've used. Soft coal cube has hardly been scratched yet

Transportation Causes Trouble

Our annual "coal shortage" is not a coal shortage; it's a transportation difficulty. And bound up with this, are our archaic methods of using coal. To avoid smoke and sooty flues and poor steaming effects, a large share of our boilers and furnaces will take only comparatively good grades of coal. Even then they get only about four or five per cent. or less of the coal's actual energy. To keep these thieves working at all, owners *have* to comb the country for reasonably good coals. It's their extremity that is one big factor in our coal difficulties. Many owners think their present plants efficient. They can well think again. If a



Actors in Our Annual Coal Drama—Part II.

Here the scene shifteth. No longer are we concerned with the producing end of the business. Above sundry commission men, wholesalers and brokers lock arms. To the right is the establishment of the local dealer. In the lower corner standeth he, himself. And below—below—is a certain gentleman with his pockets stripped. His knees are bent, and his toes turned far, far inward. He is the ultimate consumer—yourself. You recognize him, do you not?

Other Waterfalls

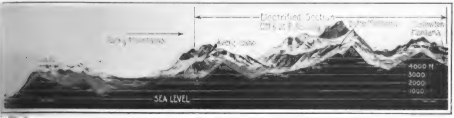
[illegible] offender in waste [illegible] stream like this [illegible] at present wasting [illegible] beauty passes unseen

A Mighty Power

While we've been huddled around feebly-responsive radiators this winter, while we have been enduring coal holidays and other makeshift remedies, we've been allowing the equivalent of at least ten tons of coal a second to go over one waterfall, Niagara. How it might look if it actually were coal, is shown above. Oh, Cedrick, if that only went in a man's bins! Farewell coal famine!

larger share of the plant owners were equipped with the newer apparatus that can burn lower grades of coal efficiently one large source of coal troubles would disappear at once. Many of the manufacturers would start out with a train of motor trucks some morning, head for a mine in their own county, and get all the coal they wanted, and often not such bad coal at that. The railroads and all their troubles would count for nothing at all. A man would be his own supply and demand. When gas and coke-making plants become more general, these things

What One Railroad Has Done



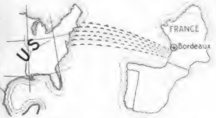
By electrically operating but 440 miles of railway, the C. M. & St. P. has effected enormous savings in coal. What it means is shown in the diagrams below

One of the powerhouses far up among the Montana Rockies

The figures are for one year's operation. We need coal in war zones badly. This railroad's savings have helped

Train driven by the energy of the restless mountain streams

Coal saved would send a destroyer on 2,368 trips around Britain



Or, it would furnish power for sending 90 transports once to France with soldiers

Forty-five destroyers could be kept steaming around the British Isles an entire year

Electrification did away with 126 engines

1,756 tank cars would have had to carry fuel if steam had been used

5,000 coal cars can now serve elsewhere

will come to pass. So also will they when the powdered coal method of burning is more generally utilized. Both systems can do wonders in the way of getting the good out of poor grades of coal.

Inseparably connected with our present railway muddle, and the fact that archaic methods of distributing and using coals make more demands on transportation facilities than any system should, are the peculiar conditions in the producing areas. There are lean years, and there are fat years. There are big operators and there are little operators. Some are located close to trunkline railroads and centers of consumption, others are at the far end of crooked, hill-dodging, weed-strewn branch lines, up which a rusty locomotive and a string of broken-down cars get once a day perhaps, and then again perhaps not. Some of the operators, because of having obtained their

coal lands for little or nothing through some mischance or other, or because they have an especially favorable situation in some respect, generally set the prices for that region. The others, in order to dig in and get business, offer inducements, or endeavor to get the upper hand in some other way. In any case trouble results. Said George Otis Smith and C. E. Lesher, of the United States Geological Survey, in a paper before the American Mining Congress at Chicago some time ago:

"In the many years our coal industry has been developing, rate structures have been built up that give to this and that producing district, differentials (in freight rates) over other districts—handicaps, as it were, that may be based on comparative lengths of haul, difference in coal qualities or mining costs, or *may merely be the survival of past practice, for which no reason now exists.*"

The italics in the quotation are ours. To one endeavoring to analyze existing opinion as to the coal situation in producing regions, that expression would seem capable of summing many of the other factors. Though only about one-tenth of one per cent of our available coal lands are at present being worked, even with that small amount we have allowed an enormous, complicated and erratic producing and distributing system to grow up. What sort of situation we would get ourselves into were we to start in on the other 99.9 per cent of our coal lands is indeed a subject for interested speculation. Coal men have written at length on such a contingency. But certainly the lack of order and system in our coal-producing regions, and in contributing factors that would tend to stabilize producing, must all have a material effect on whether or not we are to continue to have annual "coal shortages."

Prospects for Betterment

Suppose we do have coal shortages every winter, and they are due to these and those reasons, what prospect is there for bettering the situation?

One outstanding remedy for coal shortages is at present commanding the attention of the whole country. This is the development and utilization of our waterpower resources. M. O. Leighton of the Geological Survey estimates that the country has between 36,000,000 and 66,000,000 horsepower at present running idle in rivers and mountain streams. The figure runs as high as 200,000,000 horsepower, if all practicable storage sites are included in the estimate. And the noteworthy aspect of the situation is that waterpowers, once developed, are a permanent source of energy. On the other hand, when we take our coal out of the ground and burn it, it is gone forever. In the interests of our future fuel supplies we should at once start in to make good use of the part that is going to waste at present, to our great loss.

The reason our waterpowers have not been fully developed heretofore is that such restrictive legislation has been passed by Congress that men will not invest their money in plants. Franchises have been revocable by the Secretary of the

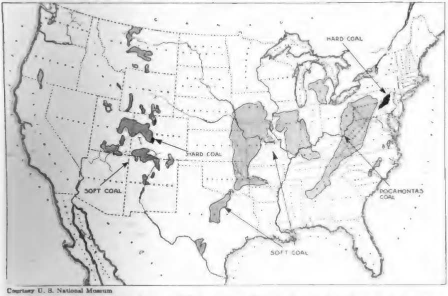
One of the huge terminal coal-handling plants, hard-pressed this winter. This one is in New Jersey

Interior at will. Would you put millions in a waterpower plant when at one stroke one man could render the investment valueless by cutting off your right to operate? This restrictive legislation we passed some time ago when many were fearful of the formation of a waterpower trust. While there may have been some danger of it at times, all semblance of such tendency has effectively been dispersed by the thoroughness with which waterpowers are bound up at present. All hands have promised to be good if only Congress will open up the way a little.

Showing wastes which go up the stack in many present plants. By-product coke plants will recover all these

At present there is a bill before Congress sponsored by the Administration and designed to allow the proper development of our waterpowers. It took the pressure of a tremendous coal shortage to focus national interest on the subject. To prepare the bill, all interests collaborated. Previously a solution had been attempted by proposing three bills, one each for the three governmental departments having to do with waterpowers. The new bill has the country's best thought behind it, and if anything will help relieve our "coal shortages" via the development-of-waterpowers route, this evidently should.

A striking instance of what the development of waterpower can do in the way



Courtesy U. S. National Museum

The hard and the soft coal areas of this country. Material inroads have been made on our **hard coal stores. However,** three to five trillion tons of soft coal remain in our lands

At left: Charging coal in a modern gas plant. Right: Tar-separating machinery. Huge plants like these will increase in number, supplanting our present antiquated fuel users

of saving coal is brought out by figures recently compiled by the Chicago, Milwaukee, and St. Paul railway. This line has 440 miles of railroad electrified between Harlowton, Montana, and Avery, Idaho. Hydro-electric powerplants driven by mountain streams furnish the power. In one year's operation startling results have been achieved. These we make clear in the figures on page 533. If all coal saved had had to be hauled up through St. Paul from Illinois and Eastern sources, think what a tremendous additional burden it would have been on the railroads. Similar savings can be effected on all roads. After the war the country will probably make immense strides in this direction.

Says E. W. Rice, Jr., president of the American Institute of Electrical Engineers:

"The waterfalls constitute potential wealth which can only be truly conserved by development and use—millions of horsepower are running to waste every day, which, once harnessed for the benefit of mankind, become a perpetual source of wealth and prosperity.

"It is really terrifying to realize that 25 per cent of the enormous amount of coal which we are digging from the earth each year is burned to operate our railroads under such inefficient conditions that the average of 6 lb. of coal is required per horsepower-hour. The same amount of coal burned in a modern central power station would produce equivalent to three times that amount of power in the motors of an electric locomotive, even including all the losses of generation and transmission from the source of power to the locomotive."

Future of Our Coal Situation

From all indications, the trend lies in the direction of the development of our waterpowers, the use of powdered coal, and the establishment of gas and coke plants. These last will take raw coal, convert it into coke, gas, and by-products. All will be efficiently used. This means a great deal for the dyestuffs industry, farming, and all branches. Says William Hamlin Childs, an authority on the by-products industries:

"A four foot vein of coal will yield enough sulphate of ammonia to fertilize the land lying above it for 1,000 years."

This, he means, is in addition to all the coke the coal will yield, and other products. Truly our present-day boilers and furnaces are inefficient in getting the good out of coal. When men get to using our three to five trillion tons of coal in the new way, what won't it do for the country?

It may be worth noting in conclusion that all England is about to make an extensive experiment in fuel conservation. As far as possible all railroads are to be electrified, factories operated from central stations, isolated plants done away with; and other marked changes brought about. Electric powerplants will be located at mines, doing away at a single stroke with railroad transportation problems. London smoke and fogs will be cut down.

If You Don't Smell All Right in a Bee-Hive, You're Kicked Out

ALL bees smell alike to average mortals, but Dr. N. E. McIndoo, whose book, "Recognition Among Insects," has recently been published by the Smithsonian Institution, has trained his nose until he can recognize the three castes of bees—queens, drones and workers—merely by smelling them. He can also distinguish several other odors peculiar to bees and their hives. His experiments show that the bees themselves recognize one another by individual odors, and use the sense of smell for as many purposes as human beings use their eyes and ears. "Worker bees returning to the hives from the field pass the guard unmolested, because they carry the proper sign, although the hive odor they carry is fainter than when they left the hive, and it is also partially masked by the odors from the nectar and pollen carried by these bees."

As you see, this military coat can be converted into a union suit if desired

A Noose Used Not for Hanging But for Life-Saving

JUST escaped, perhaps, from danger, the half-dazed fire victim often finds descent all but impossible.

To make this descent safer, Hulda E. Astarita, of Brooklyn, New York, has patented a new device. It is a simple, swinglike seat with a footboard attachment. The parts are held together by ropes, and an extra loop of rope is attached, noose fashion to both sides of the carrier about midway between the seat and the top.

This loop of rope is slipped over the head and allowed to tighten itself about the upper part of the body. Any pressure on the footboard serves to tighten the rope more securely about the body.

This new self-holding fire escape is a Brooklyn woman's invention

Turn Your Coat Tails Into Trousers for Free Movement

THE new coat shown in our illustration affords closer protection for the legs, inasmuch as it can be buttoned tightly around them. This arrangement prevents the flapping of the tails of the coat and makes walking or even running much easier. The new model also permits the wearer to crawl without difficulty and thus makes itself valuable in the trench style of warfare. A further use of the new coat is that it can be made to fit comfortably into the high rubber boots worn in the trenches, thus preventing it from slopping in the mud.

When the overcoat is not buttoned about the legs, it presents nothing unusual in appearance, closely resembling, in fact, the ordinary models.

Browning, the Gun Wizard

Old John Browning has produced the finest machine guns for our army ever invented

By Edward C. Crossman

The Mysterious John M. Browning

Who is Browning? Millions of Americans must have asked themselves that question when General Crozier, Chief of the Bureau of Ordnance, testified before an investigating committee that he had decided to equip the United States army with the Browning machine gun. John Browning has been an inventor of firearms all his life. Shotguns, rifles and pistols such as Winchester, Remington, Stevens, and Colt, are all of them John Browning's invention

AMERICA has finer guns in the Browning light and heavy type than any nation now at war. While the members of Congressional military committees vapored and fumed that blue print guns never killed an enemy, and that the unknown Browning gun was an experiment and a doubtful experiment, the officers in the Bureau of Ordnance and the great Browning smiled quietly.

We had about thirteen hundred guns when war broke out, which were of a type ordered abandoned in favor of a better one by the powers that be after the tests at Texas City. When war broke out the Germans were known to have fifty thousand machine guns—and the fact is now rather well known that they didn't advertise during 1914 *all* the war material they had accumulated.

Europe had no light machine gun out-side of the French Hotchkiss and Bénet, and they were not entirely satisfactory. When there came over the horizon the light Lewis gun, one of many American machine-gun inventions, the British waxed enthusiastic. The gun worked most of the time, weighed but twenty-six pounds, had a very easily-changed magazine holding forty-seven cartridges, and very successfully coped with the need of a light machine gun that troops could carry forward—or back—in times of need. This did not mean that the Lewis was perfect. It has been known to jam and stop and break parts. Those guns bought [illegible] United States and sent [illegible] did not prove imp[illegible] machine guns, [illegible] points in one [illegible] new [illegible] So [illegible]

[illegible]

firearms than any man who ever lived, with his identity buried under the names of the great companies making his arms under royalty agreement with him. He is the inventor of nearly all the Winchester models from the 1873 model to the fine 1906 rifle; the man who gave the world the Remington autoloading shotgun and the Remington autoloading rifle; the master who perfected the Stevens 12-gage repeating shotgun; the creator of the United States Army's Colt automatic machine gun; the designer of all Colt automatic pistols, from the largest to the smallest; the patentee of the great Government .45 automatic pistol, now the hand-gun of our troops, and the man from whom Belgium, long before the war, bought the right to make automatic shot[illegible] rifles, and pistols of different cali[illegible] models.

[illegible] Browning, the square-jawed, [illegible] American Yankee, in his [illegible] store-clothes, was made a [illegible] l'Ordre de Léopold and [illegible] the King of Belgium on the [illegible] the completion of the millionth [illegible] automatic pistol by the Fab[illegible]nale of Liége—a pistol that [illegible]erably more than a million in [illegible] and caliber without a change.

[illegible]wning made his first patented [illegible]. That weapon was the

Winchester single shot rifle. Six hundred of these rifles were made by Browning and one of his brothers in the then little frontier town of Ogden, Utah, in a little shop, from forgings made for them in the East. Then the patent was bought by the Winchester Co., and the fame of the Winchester has since spread over the world.

The older type of Browning machine gun, better known as the Colt, was adopted by this Government in 1890, and has been in use the world over since. The Colt and the Marlin plants turned out this gun by the thousands for the belligerents after the war broke out. No Browning gun has ever been discontinued in manufacture—and the record runs back for nearly forty years.

This is the man, who, a worried Congressional Committee feared, could not turn out a gun as good as the well known types—merely because it had not been taken over to the torn fields of Europe to prove its worth.

A machine gun, as you know, means in these days a rifle firing the cartridge of the infantry rifles of the army using it, and firing such cartridge at a rate of speed of from four hundred to seven hundred shots a minute by virtue of using either the recoil of the breech parts to work the extracting, cocking and reloading mechanism, or else gas taken from a tiny hole up the barrel and working against a piston precisely as gas does in the automobile form of gas engine. It is a gun that works by machinery. The old Gatling was a machine gun, but not an automatic machine gun, because its moving power was a crank in the hands of the firer. All modern machine guns are automatic.

Browning's Three Wonderful New Machine Guns

The first of the recently tested Browning guns, falling in the class of guns to be readily moved about, turned out to be water-cooled and to weigh only twenty-five pounds, which is marvelously light for a gun of this type. It must, however, be fired from a tripod which weighs twenty-five pounds more. The second was a little thing weighing fifteen pounds, the lightest machine gun ever built—more properly an automatic rifle as the modern term is coming to be for the light machine gun. Your father and mine thought nothing of shooting a duck gun weighing thirteen pounds. African hunters use double rifles going fifteen to sixteen pounds.

The water-cooled Browning gun, thus far a military secret and unlike any other Browning gun, is a belt-fed gun like Browning's old Colt. Unlike the Colt it is recoil-operated, (heretofore the recoil had been used only in the Maxim and Vickers), which means a gun in which the power of the recoiling parts is used to compress the springs and extract the cartridge, etc. The ejection is through the bottom of the receiver—toward the ground instead of in the face of some soldier happening to be beside the gun. The entire gun can be dismounted in a moment without tools.

This gun fired twenty thousand shots without a hitch due to the gun itself, and with but

Firing the Bénet-Mercier Machine Gun

The cartridges are supplied in flat strips of thirty; which feed across the gun horizontally, the clip being moved one cartridge at a time by the gun's mechanism. The rate of fire is high, about six hundred shots a minute, which means that a full clip races across the breech of the gun in three seconds. Note the flanges on the gun. These cool it like the flanges cast on the barrel of a motor-cycle's engine. The crew must swathe the gun barrel with wet sponges set on wooden handles every three rounds or oftener, which makes a pretty cloud of steam and advertises the whereabouts of the piece in the most disapproved manner

two stoppages due to imperfect ammunition, one cartridge failing to feed in, the other refusing to fire. Consider that this means twenty thousand terrific shocks to the operating mechanism, twenty thousand vicious drives backward of the mechanism when the powder pressure of fifty thousand pounds per square inch rose in the chamber for each shot. So fast does the mechanism of such a gun work that the eye cannot follow the moving parts. Imagine a single-cylinder automobile engine being asked to work twenty thousand times so quickly that the eye can't follow the piston in and out, and started from inertia to top speed in probably one-fiftieth second.

Compare this with the following official record of the Bénet-Mercier at Texas City, in August of 1914, the comparative machine-gun trials between the Bénet—the then standard type in our army—and the light Vickers rifle:

"It was found during these tests that it was practically impossible to obtain a continuous fire of 1000 shots from any of the Automatic Machine Rifles, M 1909 (The Bénet-Mercier). During two of the tests such fire was required, but owing to severe and frequent jams of various kinds, some of which could not be corrected within a reasonable time even by a skilled mechanic on duty with the board, it was necessary to discontinue this particular kind of test in so far as this type of gun was concerned."

Also, said the board, regarding the belt-feed Vickers—the same type as the Browning in feed details:

"The greater number of cartridges in container 250—resulted in a more continuous, concentrated fire from the gun. While the rate of fire of the Vickers gun is slower than that of the service machine rifle—Bénet—the actual number of rounds fired when both types of gun were working satisfactorily was in the proportion of 10 to 6 in favor of the Vickers, due to loss of time in inserting the shorter feed strips of the Bénet automatic machine rifle."

Against this Benet record of not one thousand rounds continuous fire, the Vickers guns—four of them—were fired more than sixteen thousand times—six thousand rounds from one of them without "a malfunction that could not be easily and quickly corrected by the gun crew."

This resulted in the adoption of the Vickers gun—and now comes the great Browning machine gun of much the same type—belt feed and water cooled—that was fired twenty thousand rounds with but two stoppages, both due to ammunition. The fine Vickers has to take second place.

After the adoption of this splendid new Browning, the Board asked Browning to design one on the same lines but air-cooled for airplane use. Air is efficient for an airplane gun because the rapid motion through the air cools the gun surface, where this is not true on the land. This has been done, and the gun adopted for airplane use. Water cooling is not, of course, practical for airplanes.

Browning's Airplane Gun

Browning filled the order with a fifteen-pound automatic rifle or machine gun, as it really is, gas-operated like his old Colt, and air-cooled. It is fed by a twenty-shot magazine, and, with its very light weight and small magazine, it is as much a true automatic infantry shoulder rifle as it is a

This I

Like

machine gun. It has a wooden stock like an ordinary rifle, and it can be fired from the shoulder, although hardly with automatic fire, because of the unbalancing effect of the series of hard drives of recoil. With the regulating latch set for one-shot fire, the gun fires once for each pull on the trigger, precisely like the well-known so-called automatic sporting rifles and shotguns and pistols which reload themselves by the recoil and fire each time the trigger is pulled.

The Bénet-Mercier Machine Gun

The Bénet-Mercier gun has been used by our army since 1908. It came originally from the French Hotchkiss factory. It weighed about twenty-eight pounds, which means that it can be picked up and carried by one man in changing position. Bénet-Mercier machine guns, however, come as light as fifteen pounds. This gun is operated by the powder gas passing through a tiny port in the bottom of the barrel about half way up. The gas strikes the head of a piston within a regular cylinder like that of a one-cylinder gas engine. The backward drive of this piston performs the various operations of compressing the retractor and main-springs, extracting and ejecting the empty shell, cocking the hammer, etc. Then the compressed springs drive home the bolt, with a fresh cartridge in the chamber

When the same latch is thrown down to automatic fire, however, the gun fires at a rate of speed higher than that of any known machine gun, and the twenty shots are fired in approximately two seconds! The Bénet-Mercier would take this time or longer; the Colt and Vickers three seconds. The magazine is readily replaced by a filled one.

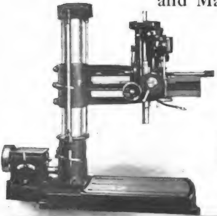
Longer box-magazines—the form in which the cartridges are carried in this arm—can be used, but the twenty-shot is intended for use in the front line, where the firer may have to hug the ground and where a too-long magazine would make the automatic rifle hard to handle.

Consider the automatic rifle section of a platoon, then, each man carrying easily over his shoulder the 15-pound rifle, and loaded with ammunition packed in spare magazines, and with still more in the hands of ammunition carriers. Using one-shot fire, the firing party can easily empty a rifle with aim for each shot in ten seconds. Then, when the rush comes or when it is necessary hurriedly to sweep a trench traverse filled with the enemy, a shifting of the latch and a burst of fire of twenty shots in two seconds! A single burst, and a twitch or two of the muzzle, and a traverse would be cleaned out. Such fire would have to be from the prone position or from the hip. No man can stand up under the repeated recoil of a light machine gun fired from the shoulder.

The only competitor the new Browning gun has is the little French Chauchat "the hellcat," used now in our army, and weighing nineteen pounds. Our experienced officers say even the twenty-six pound Lewis is too heavy for the automatic rifle work in the front line—and now every platoon of an infantry regiment has a machine gun or automatic rifle section—the terms being much the same in these days—the men of which carry light machine guns and ammunition, therefore, just as still another section carries only hand grenades. Some of the little fifteen pound terrors are now coming through the Winchester works.

So came about the crowning triumph of the Yankee, John Browning, designer of the Government's automatic pistol, and now the designer of the three most successful machine guns the world has seen, victors in fair trial over all other machine guns—the Browning water-cooled machine gun, twenty-five pounds in weight, the Browning air-cooled machine gun for planes, still lighter weight, and the marvellous Browning automatic rifle or light machine gun, fifteen pounds.

Why Not Do It with Tools and Machinery?



A large radial drill press with a power actuated arm for raising and lowering it to suit the work

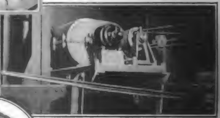
With the tapping machine shown at the right reverse is greater than the cutting speed

Portable miller to cut recesses in plates used for vessels' sides

A brick tongs is shown at center which holds seven bricks at once

An automatic electrical wrench which stops when nut is tight

A large high-speed automatic metal saw with a compartment for holding lubricating compound



This one-half horsepower motor is geared to move thirty ton cover from telescope mounting

Direct reading micrometer having disk that can be accurately read at distance of several feet

Little Helps for the Office Workman

A flexible and extensible book binder that allows the leaves to lie flat yet locked is shown below

One of the most annoying features of typewriting is to look for an eraser when a mistake is made and not be able to find it. It has to be tied to the typewriter. With this clip it can be kept handy

A new type of paper fastener for the desk. The front part cuts a tongue and turns it back through a slot, fastening several sheets at a time. The back or heel part has a punch for the cutting of round holes

A file for the flat top desk is shown at the right. It has sixty-eight compartments, one for each day of the month, one for each month, one for each letter of the alphabet. It is easily stowed

A narrow follow block for vertical letter files is shown at the left. This block is made of metal and holds the contents firmly compressed, yet when released it can be easily moved forward and backward

Check writer with five fountain pens signing five checks at once

and penholder stand for use in the office

Boxes of Air to Foil the Torpedo

William T. Donnelly's ingenious method of making cargo-carrying ships unsinkable

By Robert G. Skerrett

THE steamship *Lucia* is unsinkable. At least, such is the opinion of William T. Donnelly, a consulting engineer of New York city and a member of the Ship Protection Committee of the United States Shipping Board. Indeed, this belief is shared by his associates on the Board, and for that reason Mr. Donnelly's special system has been installed upon the ship in question.

The Boxes and What They Do

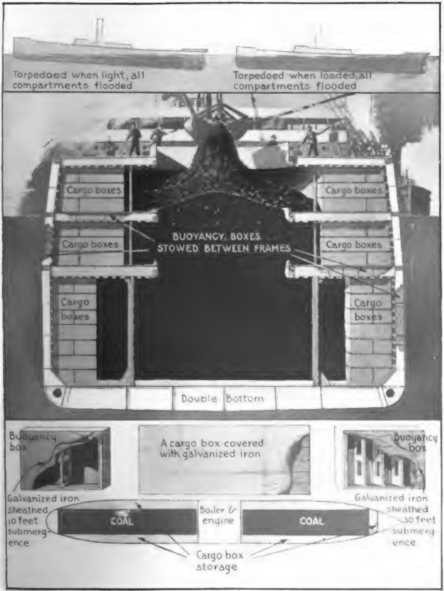
The invention consists fundamentally of a system of portable buoyant watertight boxes, which, when packed in their designed places, form a veritable honeycomb of small air chambers. By thus greatly subdividing the space allotted to them, these boxes necessarily restrict the volume that may be opened up by the destructive gases of a torpedo, and, therefore, limit the amount of water that can enter the craft so damaged.

Maritime law sets a limit to a craft's deep load-line. The underwriters will not issue insurance if that line is submerged by reason of excess weight taken aboard. While this is a very necessary safety measure, still it actually invites peril. For instance, coal represents forty-three cubic feet to the ton while the ordinary baled cotton runs about ninety cubic feet to the ton. Clearly, if a steamer of a given capacity has her compartments entirely filled with cotton, when loaded to her prescribed waterline, those holds could not be more than partly filled when carrying a corresponding weight of coal. And because there would be that volume of unused space, when carrying coal, there would be just so much more room for water to rush in in case the hull were ruptured. This water would destroy the ship's reserve of buoyancy—previously represented by free air space—and cause her to sink. The cotton cargo, on the other hand, because it has less density and more bulk than the coal, would keep out the invading sea and actually buoy the vessel at the surface in spite of very serious injury to her hull.

Cargo Space Is Not Reduced Much

Now, Mr. Donnelly stows the smaller of his portable buoyancy chambers in between the ribs of the craft and up under the decks between the beams, holding the buoyancy boxes in place in both cases by means of wooden slats or "battens," as they are technically called. The boxes are placed where freight would not be packed. These safety chambers are what might be termed a permanent feature of his plan. In order to take care of excess space in the cargo holds, if the weight of the freight and its density are such that the compartments are not filled, the inventor resorts to "cargo boxes" which differ from the buoyancy boxes mainly in the matter of size. The buoyancy boxes average one foot by two feet by three feet and weigh one hundred and three pounds apiece; while the cargo boxes are two and one-half feet by two and one-half feet by six feet and weigh three hundred and eighty-seven pounds. The buoyancy boxes displace four hundred and sixty-five pounds of water, and the cargo boxes displace eleven hundred and fifty-three pounds of water—showing plainly a large net gain in reserve buoyancy. Every box is tested first for air-tightness by submerging it in a tank, and then for water-tightness by placing it in a sealed cylinder and subjected to hydrostatic pressure corresponding to the position in the steamer.

The complete equipment of boxes for the steamer *Lucia* costs about one-tenth of the building price of the ship. Mr. Donnelly estimates that a vessel should normally be worth ten times her cost to her owners through the service she can render in the course of an average useful life. Therefore, his safety feature involves an outlay of only one per cent. of her probable returns.



How William T. Donnelly Intends to Make Ships Unsinkable

Much has been heard lately of unsinkable ships, but after the *Titanic* disaster the public became skeptical. However, Mr. William T. Donnelly, of New York, has recently advanced a new and plausible idea. Buoyant boxes are to be packed into allotted spaces, thus adding enormously to the buoyancy of the vessel. The boxes will be watertight and airtight and very strongly made. They will be placed as an additional wall between the cargo and the vessel's side. When traveling light the buoyancy boxes would suffice to keep her afloat, even though badly damaged. If loaded they would enable her to keep on the surface even though all the rest of her free space were flooded. The boxes are to be standardized and stored at shipping terminals so that they will always be on hand to fill any spare space not taken up by the cargo. The steamer *Lucia* has already been fitted with these new boxes.

Hooverizing Daylight

Not advocating a bedless day, but suggesting the readjustment of hours

These timepieces from Grandfather to Baby Ben, will all have to be reset if we adopt the daylight saving measure. In this article the whole subject is discussed. Daylight saving has been advocated ever since the days of Benjamin Franklin, when that worthy scored the citizens of Paris for their slothfulness

THE project of advancing the clock in summer in order to persuade slothful humanity to keep early hours at that season, after nearly a decade of unsuccess in getting itself taken seriously, has suddenly come to fruition under the stress of war conditions, and is an accomplished fact over the greater part of the civilized world.

A certain modest representative of the building trade, now deceased, must have chuckled in his grave when Representative Borland referred to him the other day, in Congress, as "the late William Willett, the noted scientist of England." Willett put forth his daylight-saving scheme, in a form somewhat different from that eventually adopted by the British Government, in the year 1907. The first daylight-saving bill was introduced in the House of Commons in the year 1908. Presently similar projects began to crop up all over the world. Most scientific men ridiculed them, but many of these authorities have now been converted. Then came the war, and daylight saving was one of its many startling products.

It would be quite impossible within the limits of a brief article to set down all the pros and cons of this scheme. The pros are generally familiar, because they have been embodied in numerous circulars, widely disseminated by chambers of commerce and faithfully reflected in our commercial-minded press. The cons are less well understood; but more will be heard of them when America is undergoing her first summer of dislocated time. A year or two of experience will be worth centuries of academic discussion in enabling us to decide whether we wish to save daylight indefinitely.

Western Europe has now had two years' experience with the plan, and the results are those that might have been expected under existing conditions. They depend to some extent upon latitude. In far northern countries there was really no good reason for adopting the scheme, except to bring their time-schedules into agreement with those of their southern neighbors. In high latitudes it is impossible in summer to limit sleeping time to the hours of darkness, because daylight prevails through the greater part of the night, or all of it, according to date. Hence the Norwegian Government reports the plan a failure, and similar but unofficial reports have come from Scotland.

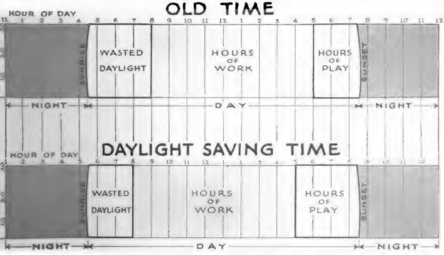
Elsewhere the plan has undoubtedly saved fuel, and it seems to have conduced to the health and comfort of a considerable part of the population. In the United Kingdom it is claimed that in the four and a half months that "summer time" was effective in 1916, the saving in gas alone represented 260,000 tons of coal, and reduced the expenses of con-

sumers by $2,375,000. Electric light companies reported a reduction of output averaging about 20 per cent. The saving in illuminating oils was reported at 2¼ per cent. of the annual consumption. In France the saving in fuel used for illuminating purposes was estimated at ten per cent. of the annual consumption. In Germany the municipal gas works at Berlin reported a decrease during May and June, 1916, of 508,500 cubic meters, in spite of the fact that 18,000 new gas meters were installed during the first six months of the same year, and the records from January to April showed an increase of 2,400,000 cubic meters of gas as compared with 1915.

Estimates vary as to the saving of fuel we may hope to effect by the adoption of the daylight-saving plan in the United States. When this phase of the question was discussed in hearings before a Congressional committee, Mr. R. I. Brunet, of the Rhode Island Committee on Public Safety, declared that in the city of Providence alone an annual saving of $60,000 was anticipated, and that in the country at large the saving would amount to something like $40,000,000. The Boston Chamber of Commerce estimates that the country will save $100,000,000 annually in the use of artificial light, on the basis of extending the plan to the entire year. The city of Cleveland is said to have saved $200,000 during the first six months after changing from Central to Eastern Time (thus permanently advancing the clocks by an hour).

By beginning their day an hour earlier than has heretofore been customary, people gain an extra hour of daylight after the regular day's work is over. This affords greater opportunities for out-of-doors recreation, and the change seems to be popular in middle European latitudes, except with the agricultural population, which has expressed some dissatisfaction at being obliged to advance a working schedule which was already well adjusted to the daylight period. Workers in other lines have, in some cases, enthusiastically described the effects of the plan as "giving them a Saturday half-holiday all the week."

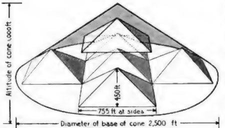
It is also reported in England that the extra daylight in the afternoon has encouraged the cultivation of gardens. Much stress has been laid upon this feature of the scheme in the United States, where it is hoped that daylight-saving will increase the general food supply and also help the individual citizen to solve the problem of high prices by raising part of the food needed for his own table. It is not at all clear, however, why the advancing of the working hours in



Here are the twenty-four hours graphically illustrated. Notice that the work hours remain the same but the play hours increase. It is switching an hour from the morning to the playtime

shops, factories and offices should not have exactly the opposite effect—by depriving the employees of the opportunity they previously enjoyed of working in their gardens *before* beginning their regular occupations.

Apparently the procedure of setting the clock forward and backward has not caused much trouble on European railways. Whether, with our much larger proportion of single-track lines, we can follow the same plan with impunity is still uncertain.



England saved 300,000 tons of coal in one year. The diagram shows the size of the heap. It is equal to a 215-foot cube

Obviously daylight-saving has much to commend it. What can be said against it? Many arguments urged by its opponents are fallacious and frivolous. It has been called unscientific, but it is purely a practical measure, with which science has little to do; it has been looked upon as immoral, because a certain amount of "deception" is supposed to be involved in it—as if there could be any deception in a mere change in conventional time-keeping publicly established by law!

The real argument against the daylight-saving scheme is that civilized humanity has a strong liking for artificial light—even though it costs money. Many—perhaps [illegible] of us have no [illegible] to go to the [illegible] the chicken[illegible] a [illegible]

that which we derive from the changeable "cyclonic" weather of middle latitudes, constituting the most stimulating of all climates, though it is hardly parallel.

That thrifty old soul, Benjamin Franklin, was an enthusiastic day-light-saver, and one of the first to formulate an opinion on the subject. In a much-quoted essay he took the people of Paris to task for lying abed hours after sun-up—a practice resulting in needless expenditures for candles.

Electricity Makes the Winding of Bandages Easier

IT is only fit that electricity, which is so widely used as an aid in the destructive work of the war should also contribute its share to the efforts of healing the wounds caused by the war. An electrical contrivance shown in the picture, is now used in the workshops of the Red Cross for expediting the formerly slow and laborious work of winding bandages. It is a reel of simple construction, driven by a small electric motor supplied with power from any household lighting circuit.

[illegible]chine winds thousands [illegible]y for our soldiers

This contrivance obviates much handling of the bandages and so prevents, to a great extent, their contamination. The greatest advantage, however, is its speed, which is a boon when requisitions for many thousands of these bandages have to be rapidly filled.

Sample House in a Suit Case for Real Estate Drummers

THE drummer or traveling salesman with his indispensable sample case containing specimens of the goods he is trying to sell is a familiar figure everywhere in this country. There are many kinds of salesmen on the road. Some sell dry goods, some offer goods that are not so dry, others sell hardware, groceries, cigars or other merchandise. But who has ever heard of a drummer selling houses? Yet, there are such and, moreover, like other drummers, they carry samples of their goods in their trunks or sample cases.

The set-up model gives a good idea of the appearance of the new house

An Eastern firm, which makes a business of building sectional houses that can be set up and taken down again whenever desired, has conceived the ingenious plan of selling these houses by samples which their drummers carry with them on their tours. The samples are cardboard models, printed in colors and partly cut out, so that they can easily be put together even by inexperienced hands. The advantage of this method is evident. Ground plans and even perspective drawings cannot be visualized readily by the average person. By showing models the salesmen find no difficulty in interesting their customers. The very fact of a man carrying a house in his sample case excites curiosity at the commencement, and coupled with interesting sales talk forms a great attraction.

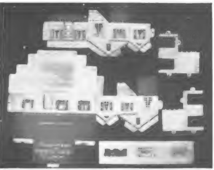
Will You Give the Navy An Eye? They Want 'Em Badly

THE Navy Department in Washington has issued an urgent appeal to all citizens owning binoculars, spy-glasses or telescopes to place these instruments at the disposal of the Government. The Navy is still in great need of such optical instruments. The use of the submarine has so changed naval warfare that more eyes are needed on every ship, in order that a constant and efficient lookout may be maintained.

Heretofore practically all optical glasses used in the United States were imported from Germany, France or England. The war has put a stop to the importation of these articles and as there is no longer any supply on hand, the Government finds it necessary to appeal to the patriotism of private owners.

Citizens, willing to come to the aid of the Navy, should send their field glasses, binoculars or telescopes, securely tagged and giving the name and address of the donor, by mail or express to the Hon. Franklin D. Roosevelt, Assistant Secretary of the Navy, care of Naval Observatory, Washington, D. C. A permanent record of the donation will be kept and the article will, if possible, be returned after the termination of the war. For each article accepted the Government pays a nominal fee of \$1. Now then! Rally 'round, and altogether, boys!

The bungalow actually built, with slight change in the construction of the pergola



Showing the model, printed on cardboard, in its sections, before it is put together

Prizes for Labor-Saving Automobile Improvements

$100 for the best labor-saver and $50 for the next best. Read these rules

MORE than four million Americans own automobiles. Most of these owners run their own cars and make their own repairs. Many of them have undoubtedly invented ingenious attachments about which others would like to know, and some have unquestionably made improvements about which the great automobile manufacturers would like to know.

All this latent, unrecognized inventive talent should be brought to light, especially at a time when we need inventions. And so the POPULAR SCIENCE MONTHLY has decided to inaugurate an automobile contest. It offers two prizes—one of $100, the other of $50—to be awarded in accordance with the rules published below. The prizes will cover at least part of the cost of patenting the inventions. The devices which win the prizes will undoubtedly be of sufficient commercial merit to warrant an automobile manufacturer purchasing the patents by which they are protected.

The main purpose of this contest is to encourage automobile owners and users to disclose their ideas.

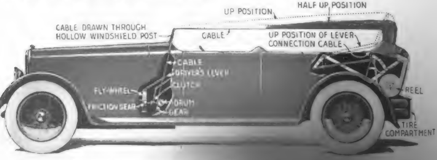
Rules Governing the Contest

1. The device offered for consideration must be labor-saving in character. In other words, its use must result in a saving of the muscular effort required to run a car or to maintain it in good condition.

2. The device offered for consideration must be commercially new. In other words, it must not be purchasable in the open market.

3. The device submitted by a contestant may be a simplification or improvement of an invention now incorporated in standard automobiles. Thus, it may be an engine starter, an electrical or hydraulic gear shift, a brake, a mechanically raised body top, a mechanical clutch throw-in, etc. But always, it must be commercially new. The accompanying illustrations with their captions will give the prospective contestant an idea of the kind of labor-saving device the POPULAR SCIENCE MONTHLY editors have in mind.

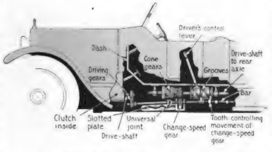
4. Contestants are not limited in the number of devices which they may submit. But only one device can possibly win the first prize and only one the second. The contest is open to everybody.



Here is an excellent instance of what we mean when [illegible] labor-saving device. This hood-raising mechanism does away with all [illegible] a lever, as it consists of a method of raising [illegible] power developed by the engine. Your drawing [illegible] should clearly show essential features. We [illegible]

5. The labor-saving device submitted must be clearly shown in one or more views. The drawings need not be made by a skilled draftsman. It is sufficient that they should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on bristol board. The views should be sufficient in number to set forth the construction and general arrangement of the parts clearly. The contestant's name and address should appear on each sheet of drawings.

6. The drawings must be accompanied by a description, preferably typewritten, in which the construction and operation of the device is clearly given. It must be written on one side of the paper only, and it should not be more than five hundred words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.



This illustration also shows a clearly detailed drawing of a device that enables a driver to change speeds without expending energy to throw the clutch in and out. It consists of three gears arranged on the surface of a cone and parallel to the base. Spiral gears connect the three main gears and allow one gear, driven from the main shaft to be slid from the smaller of the gears on the frame to another and back again without throwing out the clutch as is usually necessary

7. The drawings and description entered by contestants must be received by the POPULAR SCIENCE MONTHLY not later than 5 P. M. on April 10th.

8. The judges of the contest will be the editors of the POPULAR SCIENCE MONTHLY.

9. The following devices and processes are barred from the contest:

All compounds to be mixed with the fuel in an attempt to obtain more power.

All auxiliary air devices and similar equipment designed to save fuel by making the mixture leaner.

All parts of the engine, clutch, gear set, transmission mechanism, rear axle, steering wheel and any other part of the chassis, unless a reduction in the amount of muscular energy at present expended to drive the average automobile is obtained.

10. A first prize of $100 will be awarded to the contestant who, in the opinion of the judges, has produced the simplest, and most desirable labor-saving device.

A second prize of $50 will be paid to the contestant who submits the device next in order of merit.

11. The winners of the contest will be announced in the June issue of the POPULAR SCIENCE MONTHLY. A description of the device which won the first prize will appear in the same number, together with the name of the winner. In the July issue of the POPULAR SCIENCE MONTHLY a description of the device which wins the second prize will be published together with the name of the winner.

12. The editors of the POPULAR SCIENCE MONTHLY shall have the right to publish meritorious devices which do not win a prize. The regular space rates will be paid to the contestants who submitted the drawings and descriptions of devices thus selected.

13. Each contestant retains full property rights in the invention that he submits. The only restriction is that imposed by Rule 12.

14. When a contestant submits more than one device the description and drawing of each device must be sent as a separate unit.

15. No manuscripts or drawings will be returned to contestant unless return postage is enclosed on submission.

16. Address your drawings and specifications to the Motor Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York.

Please follow the above rules carefully.

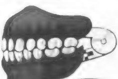

© Western Newspaper Union

When the supply of checkerboards ran out the Y. M. C. A. thought of using up old linoleum

Remember That Old Checkered Bedroom Linoleum?

WHEN the United States entered the war and hundreds of thousands of young men were drafted into the service of their country many questions arose which had to be solved. The problem of equipping, housing, arming and training the young soldiers and of feeding them in the camps and training quarters and later at the war front, devolved upon the government. Public spirited citizens and patriotic organizations undertook to provide the boys with entertainment and to supply small luxuries.

The Young Men's Christian Association decided to furnish checkerboards and men and employed a number of women to prepare the games. As the supply of checkerboards, formerly imported from Germany, was soon exhausted, boards were made by mounting old-fashioned checkered linoleum on cardboard.



How the new kind of "false teeth" would appear when inserted in the mouth of a person

Inflicting Pain to Resuscitate Victims of Electric Shock

TO the uninitiated, the treatment which a workman suffering from an electric shock receives at the hands of his co-workers is inhuman and brutal. When a lineman, for instance, stringing primary wires, has received a shock, which caused him to lose his balance and fall to the ground apparently lifeless, the first thing his working mates do is to take firm hold of the ankles of the limp body, raise it until the entire weight rests upon the back of the neck and then let it drop again. Next they will take a pair of connectors or any other heavy object and hammer the soles of the victim's feet without removing the shoes. While this is being done another comrade will pry open the mouth and yank forward the tongue, which is invariably swallowed in electric shock. By this time unless the man was instantly killed, he has recovered consciousness, the successive shocks of pain having in some way counterbalanced the effects of the electricity.

We Shall Eat When We Grow Old and Lose Our Teeth

PROGRESS in dental science clearly indicates that we shall be enabled to masticate food in old age more readily than our forefathers could. Inventors are attacking the problem in various ways, and in some recent experiments the attempt is made to imitate nature by hinging the upper and lower mouth plates in the manner shown.

A coiled spring within the hinge separates the plates when the mouth is opened. Provision is made also for the side movement of the lower plate by employing a horizontal hinge. This takes care of the usual grinding process in eating.

Oh, Henry—What Makes Them Go 'Round?

PRETTY young girls passing store windows in which a new advertising contrivance is being displayed have asked that question; old people have asked it; everybody asks it. It gets attention from all sides.

The machine recently patented by H. J. Herberts, consists simply of a polished cylinder mounted in an upright position, and resembling a restaurant coffee urn in size and general appearance. Inside an armature-like electromagnet revolves, throwing a strong magnetic field through the thin outer shell. Then when objects containing steel or iron are thrown against the shell they cling to it and move around and around it along with the magnetic field, in spite of the fact that the shell itself does not rotate. Articles journeying endlessly around the cylinder are objects of great curiosity.

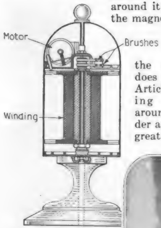
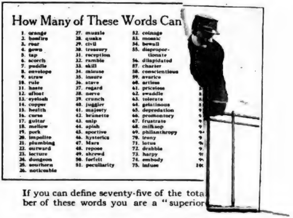


Diagram gives idea of general principles actuating the magnetic advertising contrivance

Any article which contains iron and is not too heavy will revolve 'round and 'round the drum



1. orange	27. muzzle	52. coinage
2. bonfire	28. quake	53. mosaic
3. roar	29. civil	54. bewail
4. gown	30. treasury	55. disproportionate
5. tap	31. reception	56. dilapidated
6. scorch	32. ramble	57. charter
7. puddle	33. skill	58. conscientious
8. envelope	34. misuse	59. avarice
9. straw	35. insure	60. artless
10. rule	36. stave	61. priceless
11. haste	37. regard	62. swaddle
12. afloat	38. nerve	63. tolerate
13. eyelash	39. crunch	64. gelatinous
14. copper	40. juggler	65. depredation
15. health	41. majesty	66. promontory
16. curse	42. brunette	67. frustrate
17. guitar	43. snip	68. milksop
18. mellow	44. splash	69. philanthropy
19. pork	45. sportive	70. irony
20. impolite	46. hysterics	71. lotus
21. plumbing	47. Mars	72. drabble
22. outward	48. repose	73. harpy
23. lecture	49. shrewd	74. embody
24. dungeon	50. forfeit	75. infuse
25. southern	51. peculiarity	
26. noticeable		

If you can define seventy-five of the tota[l num]ber of these words you are a "superior

Have You a Supermind? If So, You Can Define These Words

DR. LEWIS M. TERMAN, professor of education in Leland University, has introduced a new intelligence test which is said to give good results.

The words in the accompanying list were selected at random from the dictionary and arranged according to their approximate difficulty. The person is asked to begin with the simplest words, giving their definition and continuing through the list until he can no longer define them.

The test is based upon the assumption that a person's intelligence is proportionate to his vocabulary and that the ability to define a certain number of words may be accepted as an index of the person's vocabulary. The average adult can define sixty-five per cent. of the words, representing a vocabulary of 11,700 words, while the superior adult, who can define seventy-five or more of the words, commands a vocabulary of 13,500 words or over.

Moving X-Ray Pictures

See your joints move and your heart beat on the screen

This fracture is frequently unknown to the patient. He rubs it—and walks lame for good

ION radiography, a subject of ense interest, both to the pro- ssional to the lai- When en unsuccessfully attempted for the past eight years. Scientists, with the aid of the fluoroscope, have been able to see the inner working of the human body. The fluoroscope is a fluorescent screen having a hood for the protection of the physician's eyes. With this instrument it is possible to see the shadows cast by objects in the path of the X-ray.

Using X-rays to locate a fracture of the forearm. The rays can penetrate a wall

Dr. E. L. Crusius of New York city, after months of experimenting has accomplished motion radiography to the extent of showing the joints in motion. He is now experimenting to show the pulsations of the heart, the peculiar wave-like motion of the stomach in digestion, the expansion of the lungs in breathing and other organic motions in the human body.

Dr. Crusius hopes to be able to give his findings to the Government within a short time. Now that the X-ray has entered the motion picture world, the general public will be able to see how great an assistance the X-ray can be to the physician. This is especially true in surgical work in the army for tracing bullets and locating fractures.

As an example of the benefit to be derived from an X-ray examination, take the case of a fracture which is very common. This fracture is generally caused by dropping a heavy object on the foot. The injured person usually binds up the foot after rubbing on some liniment. That one of the delicate bones may be broken never occurs to him. The result of this is that the bone grows together in an abnormal position, so that all the rest of his life the owner of the foot experiences difficulty in walking. An X-ray would have revealed the fracture, the bone could have been set in the proper position and in a short time the patient would have been as well as ever.

The X-ray machine used by Dr. Crusius in his work generates five hundred thousand volts. The rays are exceedingly powerful, in fact they can penetrate a six-foot stone wall.

Section of motion-picture film of a radiograph

The exploration of one's anatomy by the X-ray is accomplished without any more pain or unpleasant after effects than would be experienced in having a photographer take an ordinary, look-pleasant-please photograph. As the X-ray is a straight ray and cannot be turned or deflected in any way, the great difficulty in making motion radiographs has been to get a screen placed between the X-ray and the camera that would not fog the film and at the same time would show the image. Dr. Crusius has accomplished this.

The Forest Skyscrapers of Australia

THE tallest of California's "big trees" is 325 feet in height, but among the great gum trees of Australia many specimens are more than 400 feet in height, and one, which was felled in southeast Australia, measured 471 feet—the tallest tree on record. Gum trees grow very rapidly.

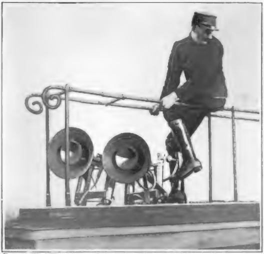
A Motorcycle as a Vibrationless Tripod

BREATHES there the photographer who has not at some time or other "lost his religion" because the wind has shaken his tripod and spoiled a plate? John Edwin Hodd, a Los Angeles press photographer who uses a motorcycle for getting about, has overcome this difficulty so far as exterior views are concerned, by the use of a universal jointed kodak fastening attached to the handle bar of his machine.

The motorcycle is placed on its stand at a convenient distance from the object to be photographed, and by the use of the universal joint the camera is pointed in any direction or at any angle. Attaching or detaching the instrument is but the work of an instant.

Because of the great weight of the motorcycle the camera is held perfectly rigid even in a strong wind. Clear-cut, perfect pictures are the result, and the necessity of carrying a tripod is avoided. The attachment is not in the way.

This press photographer uses his motorcycle as a firm, portable camera tripod



French Official Photo

Sirens on top of the Equitable Life building in Paris give warning when German raiders are approaching

Sirens Give Warning of the Approach of Raiders

IN the French cities warning of German air raiders is given by sirens of different construction, some electric, others worked by compressed air or steam. The sound of these sirens is so powerful and penetrating that it can be heard for miles even under unfavorable conditions. Lookouts are maintained at elevated points and day and night close watch is kept upon the horizon line in the direction toward the enemy.

Paris itself, however, has been almost immune from aerial attack. To cross the anti-aircraft guns and to elude the patrolling airplanes is practically an impossibility since the retirement of the enemy.

Why Tanks Are Giant Caterpillars

Armor? The Caterpillar has it. Traveling treads? The Caterpillar has them too. Machine guns? It has a poison squirt-gun

By John Walker Harrington

THE motion of the most formidable and terrifying of modern war machines has often been compared with that of the lowly larva from which comes the radiant butterfly. This famed cruiser of the battlefields might never have been, but for the invention of the farm tractor of Benjamin Holt with its caterpillar tread. Through the courtesy of Captain Haig, of the British Army, who is here demonstrating the pride of the English arms, the writer was permitted to spend nearly an hour within the Britannia, and at every point he was more and more impressed with the idea that not only does the tank resemble the caterpillar in movement, but that there are strange likenesses in structure, in armor, and even in control between the two objects.

The tank is a high-powered, armored automobile differing from the war motorcar in that it moves not on wheels but on two steel belts traveling on the heavy metal frames on either side of its diamond-shaped body. The belts consist of shoes ingeniously linked together in endless chains. Each shoe has a flange, with which the tank can lay a firm hold on the ground. The belts are fitted to heavy sprockets. The rear sprockets are connected by gearing with the powerful engine in the back of the tank. The front sprockets are idlers over which the belts glide. There are also wheels which rest on the upper surfaces of the belts. At the top of the frames are rollers over which the belts pass. The tank is really laying down twin tracks or a railroad of its own.

The body of the average caterpillar consists of thirteen segments, four of which belong to his thorax or, dropping into mechanical terms, his fore compartment, while nine are assigned to the abdominal section. The number of segments varies with the species. The chest portion has three pairs of true legs, so called because they are well jointed, easily controlled and muscular. They are protected with horny sheaths and are in effect armored. With these true legs the caterpillar can steer himself, help himself along a twig, or seize leaves.

The pro-legs, or false legs, appear on at least five of the segments, duly paired. In their structure they resemble the shoes of the tank belts to some extent and they perform the same functions. They are fleshy unjointed protuberances rather than limbs. At the bottom of each one are minute hooks which are used automatically in giving the animal a hold on the surface he is traversing. They are for clasping, and in fact the rear pair are so modified as to be called claspers. Now, if a caterpillar could keep his pro-legs or shoes moving over his head and over his tail in an endless chain arrangement, his resemblance to the tank as far as the locomotion details are concerned would be perfect.

Some of the caterpillars have such a rapid, undulating movement, that it is hard at first to analyze its elements. The caterpillar actually walks by extending and contracting the fleshy segments of his body, the power being transmitted mostly to his pro-legs.

Any one who has seen the fuzzy larvae of the tussock moth going up a tree trunk will realize that the caterpillar is happy at any angle. The same principle of construction illustrated in that insect permits the tank almost to stand on end without losing balance.

For the sake of simplicity, the wheels at the rear of the tank by which it was once steered have been discarded and the direction is given by running the two belts at different speeds. The landship is rudderless. The caterpillar can twist his segments at the jointures.

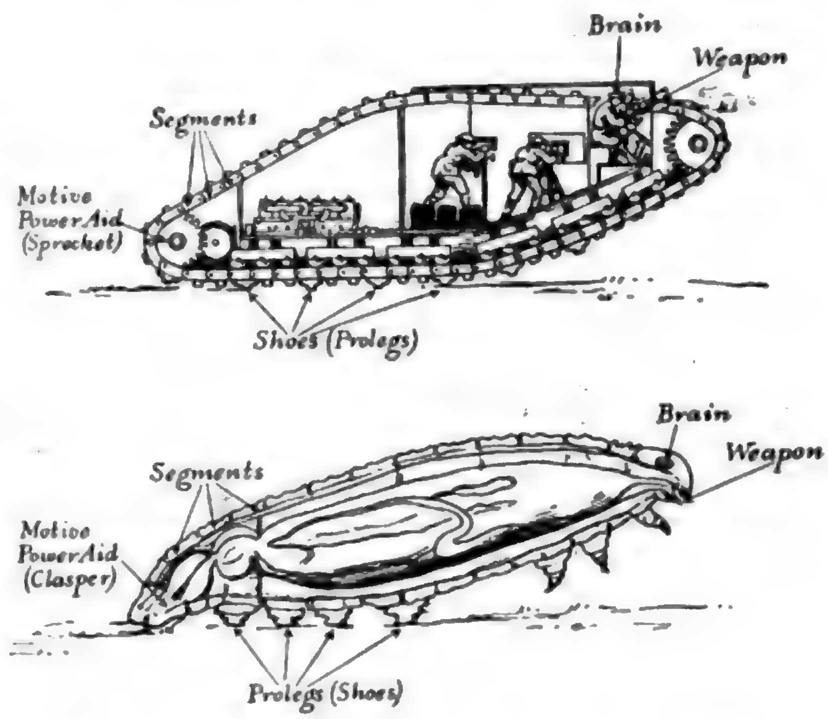
The observation facilities and guide centres of both are in their forward compartments. The commander of a tank and the driver sit well forward in the Juggernaut, looking out of very narrow

This comparison shows clearly the resemblance between a tank and a caterpillar. The artist has drawn them to such scale that they are both the same size and the immediate surroundings of each are in proportion. Suppose a caterpillar as big as a tank came marching over our fair country. Suppose he were eight feet wide and twenty feet long —the size of a tank—what a frightful monster he would be! Yet this is approximately the appearance of a tank to the Boches. No wonder that they cause such consternation

slits. When it is necessary to close the slits on account of rifle fire, the pilot gropes his way as best he may. The captain or lieutenant in command is the brains of the steel-clad caterpillar.

Caterpillars have fairly active brains and a good workable ganglia, or nerve center. On either side of the head they have small, shining eyes in rows. They also get good information about the nature of the surface over which they are passing by lowering delicate filaments or sense organs known as papilli.

The British tank is a terror to the Teutôn infantry as it starts relentlessly over No Man's Land, crushing everything within its reach and mowing down the enemy. It brushes aside wire entanglements, shatters dugouts and forts of reinforced concrete and slays cowering wretches in the trenches whose cries for mercy the men in the car of death cannot hear. What the tank is to modern battle, the caterpillar may well be in the wars of the insect world.



A tank and a caterpillar are first cousins. Notice the wonderful likeness in mechanical detail

Imagine what a vision of frightfulness that hideous specimen of the larval state, the hickory-horned devil, would be to the human race, if he were enlarged to tank size, approximately eight feet wide and twenty-eight feet long! What a sight to make men's knees shake with fear, with his waving antennæ, his fierce and gleaming jaws, his towering horns, his beady eyes, and his ponderous bulk! He would ignore all obstacles as he went trampling and devouring over the plain, his vertical mouth opening and shutting meanwhile like a ponderous valve.

In the realm of twigs and leaves, the cry "The Caterpillars are coming!" must mean as much as the alarm "The Tanks! The Tanks!" means to the Germans. The caterpillar is not the inoffensive slug which he often seems to be as we look down upon him as he bestirs himself across some woodland walk. His hide is very thick, and underneath it is a heavy layer of fat. The doughty warrior ants coming out with their nippers to assail him, do not worry him much. Up goes the tank of the world underfoot, and down he comes with a swing of the forward part of his body and a group of his enemies are crushed to extinction. Several varieties of caterpillars have very effective weapons of offense. The species from which comes the swallow-tail butterfly mounts a rapid-fire poison-gas gun. When he is hard pressed by his enemies he will project from his head a tube which looks not unlike the barrel of a Lewis machine-gun, and discharge an odor so offensive that insects within scent of it curl up and die.

The camouflage of tanks and caterpillars is effective always. "Old Crusty" at the western front and "Old Crawly," of the garden both resort to disguise. The tank is often painted the hue of the mire; the caterpillar assumes the tone of the soil.

There scarcely seems a characteristic, therefore, either of the fuzzy denizens of the foliage or of the monster military mechanisms which may turn the tide of this war, which does not reveal that, after all, the terrors of the terrain are caterpillars titanic.

It seems, after all, as though "there's nothing new under the sun." We copy the fish for submarines, the birds for airplanes, and now the tank is just a glorified caterpillar.

How to Keep the Moisture in Cheese

CHEESE would not get stale and dry so quickly if proper care were taken of it as soon as it comes into the kitchen. If a whole cheese is bought at one time, after the first slice has been taken out of it, the flat side of a warm knife should be rubbed over the cut surface. This closes the pores and keeps the cheese moist.

Whenever possible, cheese should be wrapped in oiled or parchment paper. When such paper is not obtainable, cheesecloth which has been moistened in salt water and then wrung out almost dry, may be substituted.

It must not be kept too moist or it will go moldy.

© Int. Film Serv.

These particular infants-in-arms are automobile foot-warmers used in a New York heatless street-car

"Stretching" a Pound of Butter to Make Two Pounds

TWO pounds of good table butter out of one pound and a pint of milk? Yes, it's done.

The churn which performs the feat was recently placed upon the market. It is square in shape and heavy of glass, and the churning mechanism, entirely of metal, is attached to the glass churn by a metal screw cap. In making the "stretched" butter the churn is warmed before the milk and shaved butter are put in. After stirring one minute the whole churn is placed into cold water and the operation is completed by churning for another minute. Salt and, if desired, some coloring should be added before churning.

Churn which makes one pound of butter into two pounds thereof

They Carried Stoves in Their Arms And Kept From Freezing

THEY sat huddled up together, four chorus-girls, in a freezingly cold New York street-car on one of the days that New York shivered and wondered whether it would ever be warm again. Each girl held in her hands what looked like an oval-shaped can wrapped in some fabric.

"What are they holding?"

Everybody in the car asked himself that question.

The mysterious cans proved to be automobile foot-warmers, heated by charcoal. Carrying a stove in your arms must have its pleasant side, judging from the expressions of the girls in our photograph. They would be awkward for shopping though.

Photos © Western Newspaper Union

Our illustrations show monuments to the patriotism of the women of America and England. The lower one shows a collection of trinkets donated by English ladies, and the upper one by American ladies, to help the fight for democracy

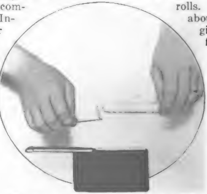
Trinkets and Jewels—Into the Melting Pot to Help Win the War

WHEN the aviation committee of the National Special Aid Society, decided to raise a fund for the benefit of the aviation branch of the American army, the chairman of the committee, Mrs. William A. Bartlett, adopted a novel method for accomplishing the purpose. Instead of appealing for cash contributions, the committee sent out a call for trinkets of valuable metal. The response was immediate. Our picture shows Mrs. Bartlett sorting over a box full of mugs, vases, teapots, brushes and other articles of silver, which had been sent to the committee by patriotic women. These articles are taken to the United States Assay office and melted for the metal in them. The Government sends its check for the metal value of the trinkets to the fund. The money is to be used for the benefit of the American aviators and the welfare of their dependents in case of disaster.

In England the Duchess of Marlborough started a fund for Child Welfare, and many women, distinguished in society, contributed generously by donating some of their jewels to be sold for the benefit of the fund. The accompanying picture shows some of the most valuable jewels contributed. The hair ornament at the top, a rope of pearls and diamonds with thirteen clusters, was the gift of Lady Ward; the aquamarine and diamond corsage ornament in the case was contributed by Mrs. Cecil Baring; Lady Henry donated the turquoise matrix brooch surrounded by diamonds.

Carry a Stove in Your Pocket and Keep Warm

THE Japanese pocket stove has made its way around the world. It consists merely of a metal box with a sliding lid, and covered with cloth. The unique feature of the stove is the fuel, which is sold in the form of sausagelike rolls. These will burn for about three hours without giving off any smoke or fumes.



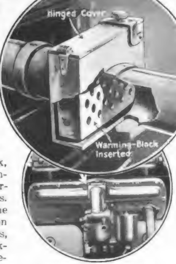
The stove and fuel here illustrated will radiate heat continuously for three hours

The fuel consists of vegetable materials, converted into charcoal, mixed with saltpeter, and pressed into cylindrical form. These are dried in the sun and then wrapped and packed.

This kind of stove was extensively used by the Japanese soldiers in the Russo-Japanese war.

Starting the Kerosene Car from the Kitchen Range

ONE of the most unusual devices yet invented for heating kerosene fuel when an automobile using such fuel is to be started, consists of a rectangular metal block with holes punched through it. This is heated by being placed for a few minutes over the kitchen gas range, or coal stove, and then inserted in a similar sized rectangular box, placed in the intake manifold, between the carburetor and the cylinders. When starting the car, the kerosene fuel is heated on its way to the cylinders, so that it vaporizes quickly. The block is not removed until again required.



The metal block is first heated against the stove

The Aerautomotricycle — a Weird Machine Made by a Doctor

FOR a cool spin on a hot afternoon, the vehicle shown herewith has conspicuous merits. The propeller in front secures an effective and bracing air bath for the driver.

Mechanically, this vehicle demonstrates that the three well known elements, a tricycle, an air-cooled "V" motorcycle engine and a propeller can be combined, and how showy the combination can be made. The gasoline tank at the top, with its pointed ends to pierce the atmosphere, suggests great speed. If the propeller were at the rear, close to the engine, the machine would look common, as there would then be no need of the long overhead frame of tubes or the complicated steering, and much vibration of the propeller shaft would be suppressed and escape notice. Actually, the propeller blades are made of thin sheet metal for lightness, and therefore have to be braced with guy wires. This type of blade—the same as that used for the cooling fans of automobiles—consumes much more power than it returns in propulsion. By virtue of this property, which under other circumstances might be termed a defect, it tends to keep the engine busy and quiet even at the very moderate speeds for which the vehicle seems best suited. There are no springs or other means for moderating road shocks and vibration of the whole structure. As it appears in the photograph the machine is harmless, the chain being removed from the large sprocket wheel on the drive shaft, but it gives an excellent idea of its appearance as it runs around the city streets and avenues. The machine has given its owner much pleasure and amusement, both in its building and running.


Tricycle with engine-and-propeller mechanism built by an enterprising and ingenious physician of New York City

Dealing Death with Depth-Bombs

How depth-bombs and new sea tactics are foiling the submarines

By Lloyd E. Darling

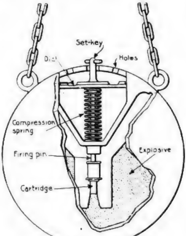
WHAT is the reason submarines have occupied less and less of the limelight recently? How does it happen that their ferocity has proven not so unconquerable as at first thought?

It's a good old American reason—pluck and inventive genius.

We should announce at the beginning that the tactics of American destroyers operating in the submarine zone are just the opposite of what has been current practice. Every time our destroyers see a submarine, they head straight for it. The old idea was to circle around and take pot shots every time opportunity offered. The new idea works havoc with the plans of underwater plotters.

But suppose our destroyers do head straight for the submarines—how do they do any exterminating even then? Answer: Depth-bombs.

Let us pause for a moment and consider how two American destroyers, the *Fanning* and the *Nicholson*, recently disposed of a U-boat with depth-bombs. The incident, as variously reported in the Associated Press despatches, was exciting. We may retell it as follows:



Depth-bomb mentioned by E. F. Chandler. Water enters through holes, pushes dial or diaphragm. Spring, regulated by set-key, opposes the pressure. At proper depth pressure causes explosion

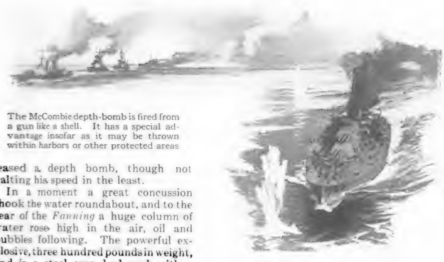
Wherein One Submarine Succumbs

"Periscope two points off the starboard bow!" called a lookout on the *Fanning*. Instantly an alarm to general headquarters was sounded and the helm thrown hard over. Signal flags were swung out, notifying the sister ship of the exact location of the enemy. At the same time the heliograph began its staccato flashing of orders for a combined attack.

The submarine submerged. Straight for the spot where last it was seen went the *Fanning*. Arriving, the commander re-

...r the last time. ...neans business

Crew of submarine surrendering to United States destroyers *Fanning* and *Nicholson*

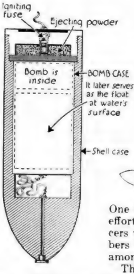


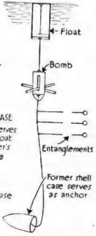
The McCombie depth-bomb is fired from a gun like a shell. It has a special advantage insofar as it may be thrown within harbors or other protected areas

leased a depth bomb, though not halting his speed in the least.

In a moment a great concussion shook the water roundabout, and to the rear of the *Fanning* a huge column of water rose high in the air, oil and bubbles following. The powerful explosive, three hundred pounds in weight, and in a steel case, had sunk with a little splash into the destroyer's wake, bringing its message of death and destruction to the shark-like craft.

Meanwhile the *Nicholson* had arrived on the scene, and it too dropped a depth-bomb. Then both boats began circling the area waiting developments.





Upon the McCombie bomb's alighting in the water, a water-ignited fuse sets off ejecting powder. Thereupon bomb separates into three parts, a float, the bomb, and outer shell-case itself

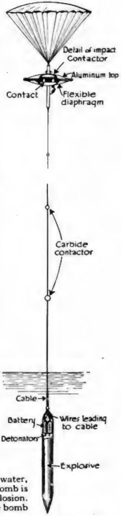
At center of page is bomb before separating into its three parts. Parts after separation are at left. Entanglements catch on passing ship, draw bomb against its side, projecting glass tubes containing fuse-mechanism break, and bomb explodes

Inside three minutes developments came. With a splash of water the submarine suddenly appeared on the surface, like a great whale coming up to breathe. It behaved erratically; was evidently unmanageable. The *Fanning* again bore down, firing from the bow gun. The *Nicholson* also closed in. But only a few shots were necessary. Out piled the entire German crew, holding up their hands in token of surrender. Before they could all be transferred the U-boat sank from under them, never to return. Some of the American crew jumped into the water in an attempt to save stragglers. One drowned however, in spite of these efforts. Another later died. Four officers were captured, and thirty-five members of the crew. The submarine was among the largest in the Germany navy.

This is one case of effective work on the part of depth-bombs, and of American sea strategy. It is typical.

Depth-Bombs Are of Many Kinds

What are depth-bombs? Trinitrotoluol or other high explosive in a container. Detonated under water, they cause a



Hallock parachute depth-bomb. Flexible diaphragm, upon striking water, closes a pair of contacts. Circuit through the electric cable leading to bomb is thus closed: bomb explodes. Length of cable determines depth of explosion. If the diaphragm contactor fails to work, carbide contactors set off the bomb

violent compressive wave to go out, caving in the side of a submarine in the vicinity as if it were an eggshell.

According to Edward F. Chandler, a New York expert on underwater developments, one type of effective depth-bomb depends solely on water pressure for explosion. The illustration on the right shows details.

The bomb may be of any convenient exterior shape, and is customarily equipped with two eyes for the attachment of supporting chains at the stern of a destroyer, or other convenient point. The [illegible]erwater pressure acts simply. Pushing in on the diaphragm shown, it causes a detonator to be fired and the explosive set off. The particular depth at which detonation occurs may previously be fixed by adjusting the bolt which projects through the diaphragm and outer shell of the bomb. A graduated scale reading in feet makes this easy. The bolt tightens up or slackens the coil-spring pushing on the underside of the diaphragm, thereby making a correspondingly greater or lesser water pressure necessary to compress it and produce an explosion.

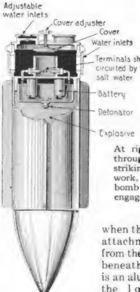
Evidently the type described by Mr. Chandler is the result of evolution, and it

probably is the most effective yet developed. However, many other kinds have been patented. A Virginia man named Dunlop produced the one depicted on page 566. This is exploded through the driving in of a pair of wings upon the bomb's striking the water. These wings release a suitable clockwork, which must run a short time before the primer is set off. Meanwhile the bomb is supposed to be sinking as a result of its initial velocity in striking the water. Whether or not it would always do this, and whether the complicated clock mechanism would always run properly is open to doubt. But obviously a clockwork is one way of exploding a depth-bomb and probably many working on the general principle are in current use. None of the Allied governments will tell precise details of the latest developments in depth-bombs, for the Germans would be too interested. But from a consideration of general types already known in the depth-bomb field, an idea of the underlying and fundamental principles may be obtained.

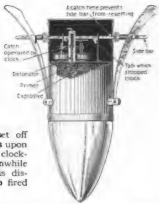
Airplanes Use Depth-Bomb

Not all depth-bombs are dropped by destroyers. Airplanes have used them with great success. On page 564 we show a type produced by W. J. Hallock of Jersey City. The explosive is contained within a long, pointed cylinder at the upper end of which is a detonator and a small electric battery. An insulated electric cable containing two wires is attached to the upper part of the cylinder, and leads to a relatively small parachute which serves to straighten out the cable

How an airplane "gets" a submarine. A depth-bomb causes a tremendous explosion caving in a submarine anywhere in the vicinity. No wonder German submarine crews mutiny!



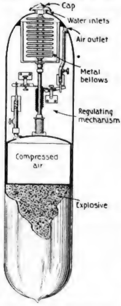
At left: Another Hallock depth-bomb. This one explodes through the action of salt water entering through the sides and top of the upper end and short-circuiting a pair of terminals. Depth of explosion is regulated by adjusting the openings at which the water enters



At right: Dunlop bomb, which is set off through the driving in of a pair of wings upon striking the water. Wings release a clockwork, which runs for a time (meanwhile bomb is sinking), then a firing-pin is disengaged, a primer set off, and the bomb fired

when the bomb and its attachments descend from the airplane. Just beneath the parachute is an aluminum disk on the lower side of which is mounted a flexible diaphragm. When the diaphragm strikes the water in trailing along after the bomb at the end of the cable, it is driven inward, and causes an electric contact to be made between the ends of the wires coming up through the cable, which, in turn, causes the bomb's explosion at a depth below the surface determined by the cable's length. Should this impact contactor at the diaphragm fail to set off the bomb, other pairs of contacts are provided at intervals along the cable's length. These are separated by pieces of calcium carbide, or starch, and are suitably protected from mechanical injury. The carbide or starch dissolves, allowing the contacts to come together and explode the bomb.

Another of Mr. Hallock's inventions is shown above. This one is without a parachute and explodes by the action of salt water entering at the sides and top of the upper end, and completing an electric circuit through the pair of electrodes shown. The depth at which the bomb is to explode is regulated by adjusting the size of the openings admitting water. The smaller the opening the longer the bomb can descend as a result of its initial velocity before flying into atoms.



The Leon depth-bomb—one type. U. S. Government has experimented with these considerably during past year. Here regulating mechanism for keeping bomb at a pre-determined depth is shown. Pressure of water actuates a bellows. This opens and closes a compressed air supply just enough to keep bomb at depth desired. Firing mechanism not shown

It is a curious fact, discovered since the war began, that an airplane when high in the air, can frequently see a submarine plainly, even though it be submerged as much as one hundred feet. Naturally the depth varies with the clearness of the water in any given region, but surprising results have been attained. A submarine is visible under water from a height for the same reason that a nickel is visible in a pan of water when your eye is directly over it. Should you get your eye off to one side and almost to the level of the water in the pan, refraction (light-bending) effects would enter in, as well as reflection of other objects to your eye from the water's surface. In consequence you could not see the nickel. It is for the same reason that one can rarely see the bulk of a submarine under water from the deck of a

ship, though it may be perfectly visible from an airplane. The man on the deck can see only reflections from the choppy waves. He is too near the surface.

K. O. Leon, a Swede, has patented in this country an unusual depth-bomb mechanism. The sketch on page 566 gives details. The Government has experimented extensively with this type and its variations. The peculiar feature about this machine is that it is designed to keep a depth-bomb at a certain predetermined depth beneath the surface, to remain there until contact with an underwater prowler sets it off. A metal bellows at the top of the bomb is filled with air and is surrounded by sea-water which enters through the topmost point of the bomb's case. Naturally, the pressure which this water is capable of exerting varies with the distance the bomb happens to be beneath the surface. Mr. Leon has not disclosed in his patent the particular type of firing mechanism he uses with his bomb.


How a submarine under water looks to an airplane above. It makes a fine depth-bomb target

T. G. Fitz G. McCombie has invented a type of depth-bomb to be fired from a gun. The bomb can thus be dropped among enemy ships with the readiness of a shell, yet possesses the submerged exploding feature so destructive to a ship's plates beneath the water line. The figure on page 563 shows details.

All reports from the zones where submarines are operating indicate that depth-bombs are almost the universal means of going after and "getting" underwater prowlers. While other means for exterminating U-boats will be evolved during the war, few can be so simple and effective.

The War Hath Slain Its Millions, but the Nursery Its Ten-Millions

WHO is the safer, a soldier in a Flanders trench, or a baby in an American cradle? Statistics would seem to show that the soldier has much the better chance of living to a green old age.

The statement recently made by Secretary of War Baker, and the statistics published by the Prudential Insurance Company of England, both agree that the mortality among the men at the front is just about twenty out of a thousand—two per cent. On the other hand the death-rate among babies, before they reach their first birthday, is one hundred and forty out of a thousand—fourteen per cent. It will thus be seen that a soldier has a sevenfold better chance of living than a baby.

The worst part is that all this baby-killing is due to ignorance and negligence. Improper foods and clothing, and the criminal ignorance of both midwives and mothers are the underlying causes. Food is one of the things about which the greatest ignorance is displayed. Conditions can be imagined when a certain city found it desirable to print notices saying "Beer and Pickles are Bad for Babies!"

It is estimated that at least fifty per cent of infant deaths are preventable, proved by the fact that in other countries the death-rate for the first year of life has been cut to half that of the United States and that certain cities in the United States have cut their infant death-rate to less than half the average for the country at large.

The mechanical cashier. This machine collects, sorts, and counts various coins

It Eats Nickels and Dimes and Counts 'Em Too at the Same Time

A NEW fare register is being used at subway stations and various other places. It does away with the selling of tickets.

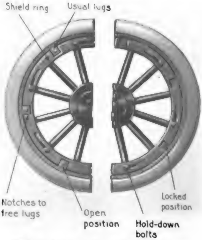
The passenger drops his coin into the hopper. It passes on to a revolving drum, and then to a revolving pan having three holes in it. Any penny, nickel, or dime is brought by this pan to the counting table. Coins of larger denomination cannot get into the machine. At the counting table a sorter gear rotates a cam on which are three projections adapted respectively to catch the pennies, nickels, and dimes. These then register and total up, an indicator at the top of a short column at the upper part of the machine showing the total number of fares paid to date and also the amount in the register in dollars and cents.

If a man has a nickel he can drop it in the hopper and immediately pass to his train without losing time buying tickets.

Loosening all the Lugs of a Demountable Rim at Once

IF you own an automobile you know just what it means to have a tire puncture. You have to unbolt each clamping lug in order to remove the rim and then adjust and tighten each into position when the rim is replaced. If you have six bolts to unscrew and then tighten, each one takes you about two minutes—a total of twelve minutes. What a saving and a blessing it would be if all the clamping lugs could be released at once and clamped back into position at once.

Mr. R. G. Mason, a Brooklyn inventor, has made this possible and thus you can change your tire in almost no time at all. He mounts a heavy locking ring outside or in front of the clamping lugs on the side of the wheel felly. This ring has openings corresponding with the lugs, and by moving the ring the detachable part of the rim can be taken off and put on in one operation. Turn the ring until the openings are opposite the lugs; the rim can be removed because the lugs are loosened. Now when the lugs are to be readjusted and locked into position, the ring is shifted again until the solid portions of it are opposite the lugs. The illustration shows the details.

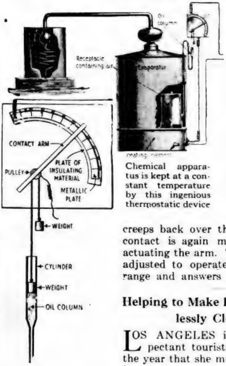


This device pares down the minutes and the trouble in tire-changing operations

This Regulator Will Keep Your Apparatus at a Constant Temperature

IN fractional distillation and other chemical operations it is often necessary to keep the material which is being used at a constant temperature for many hours, or even days. This is particularly difficult when electricity is used as the source of heat.

Mr. Louis Velasco, of Wilmington, Del., has invented an improvement for automatic thermal cutouts for electric circuits which is adapted for use in connection with heating apparatus. After the heat has reached a predetermined degree the current is shut off until the temperature falls to a given point, when the current is again switched on and the temperature again rises.



Chemical apparatus is kept at a constant temperature by this ingenious thermostatic device

A receptacle containing air, or other gas, communicates by means of a small diameter tube with a glass U-tube containing oil, on the outside of the evaporator. As the temperature rises, the expansion of the air in the container forces the oil around the U-tube and raises a weight which rests on the surface of the oil. This motion is transmitted by a string to a pulley, to which is affixed a contact-arm which makes contact on an arc-shaped piece of metal. As the temperature continues to rise the arm is moved over the metal plate until at length it passes beyond it and so cuts off the current. When the temperature falls again, the gas in the container, following Charles' Law of Temperatures, contracts and the contact arm creeps back over the plate until at last contact is again made, the weight now actuating the arm. The apparatus can be adjusted to operate over a considerable range and answers its purpose very well.

Helping to Make Los Angeles a Spotlessly Clean Town

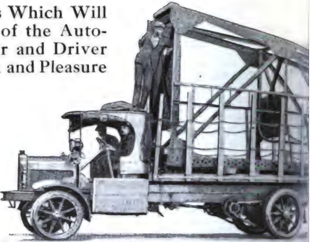
LOS ANGELES is on display to expectant tourists so many months of the year that she must always be dressed for company.

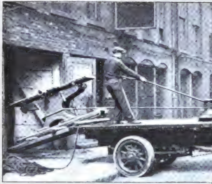
One man is employed exclusively to paint the water hydrants. This single little item in keeping the city well groomed requires, besides the services of a painter, a specially built buggy in which the necessary equipment is carried in a neat box behind the seat.

The painter's equipment is carried in a neat box behind driver's seat of this specially built buggy

It is carried on under the direction of the local fire department.

Conveniences Which Will Ease the Lot of the Automobile Owner and Driver in Both Work and Pleasure





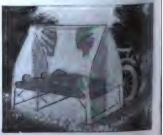
Motor-truck with capstan driven by the motor which is used for loading heavy articles such as machinery or big castings

A radiator cap accessory that produces a fountain in a glass gage as long as the water is circulating properly

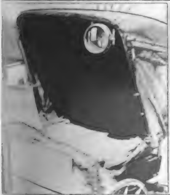
An easily constructed tire stand for making the work of tire repairs less tedious. Note the handy tool box and the solid construction

A coil about the stem of radiator cap for returning condensed steam to car radiators

A folding bed for the auto-camper, which may be used with or without the tent cover. The very thing for the outdoor man

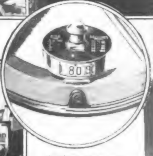


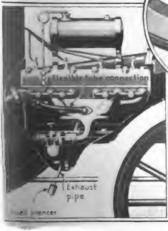
With this trailer large structural steel pieces may be hauled from the shops to the place of construction with a motor truck. Much time is saved by being able to set up these large pieces *en masse* instead of building them



The ordinary farm buggy obeying the law with a real acetylene headlight

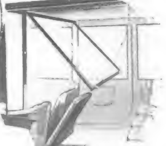
The body of this coal truck is mounted on a turntable revolved by hand





A tire gage attached to the valve stem: Driver can see pressure any time

At left: Kerosene vaporizer within the inlet manifold, heated by the exhaust



Swinging partition and drop center back change limousine into sedan whenever desired

Conquering the Poles by Airplane

Shall we be able to skim to the north pole by airplane? Read Admiral Peary's prediction

"IN the very near future," says Rear-Admiral Robert E. Peary in a new book, "Secrets of Polar Travel" (Century Company), "the biting air above both the earth's poles will be stirred by whirring airplane propellers. The last three years of war abroad have advanced the development of the airplane to such a degree that the time is now very near when airplanes will have such extended radius of flight as will make the preliminary reconnaissance of the unknown areas in the north and south polar regions a matter of a few weeks instead of several years."

The idea that aviators can now probably cover the ground to the poles in only two or three days' actual flight is fascinating. The old way takes two or three years and is attended with many hardships. Admiral Peary tells many interesting features about the country which polar explorers will encounter.

Arctic and Antarctic Are Unlike

"North polar and south polar regions are very unlike. Few people appreciate the differences. The north pole is situated in an ocean some fifteen hundred miles in diameter, surrounded by land. The south pole is on a continent twenty-five hundred miles in diameter surrounded by water. At the north pole I stood upon the frozen surface of an ocean *more than two miles in depth*. At the south pole, Amundsen and Scott stood upon the surface of a great snow plateau *more than two miles above sea level*. The lands that surround the north polar ocean have comparatively abundant life. Musk-oxen, reindeer, polar bears, wolves, foxes, Arctic hares, ermines, and lemmings, together with insects and flowers are found within five hundred miles of the pole. On the great south polar continent [illegible] of animal life appears to exist. [illegible] being in an ocean [illegible] the south pole. [illegible] four hundred [illegible] forty years [illegible] great [illegible]

expression "cold as Greenland" is all too true. Probably the coldest regions in the world are atop of its mountains of ice far inland during the long winter nights, when neither sunlight nor the tempering winds of the ocean reach the region.

Greenland Is Buried in Snow

"The interior of Greenland," says Admiral Peary, "is so cold that it gets virtually no rain, and the snow does not have a chance to melt in the long summer day. So the snow has accumulated century after century until it has filled the valleys, and not only leveled them with the tops of the mountains, but the highest of these mountain-tops have been gradually buried hundreds and even thousands of feet deep in ice and snow. Today the interior of Greenland, with its fifteen hundred miles in length and some seven hundred miles in maximum width, rising from four thousand to nine thousand feet or more above sea-level, is simply an elevated and unbroken plateau of compacted snow.

"On this great frozen Sahara of the North the wind never ceases to blow. It invariably radiates from the center of the ice-cap outward, blowing perpendicularly to the nearest portion of the coast land, except when storms of unusually large proportions sweep across the country. So regular are the winds of these regions, and so closely do they follow the rule of perpendicularity to the coast, that it is always easy to determine the direction of nearest land."

Over such country as this will the airplanes fly. In south polar regions much the same conditions will exist, except that aviators must fly at greater altitudes because a continent rises high beneath them. Many geographical facts about polar regions are as yet undetermined. Those last lands unreached by man may be about to yield their secrets.

What the lands may contain is problematical. New races of men, perhaps, new [illegible]d valuable hunting-grounds for fur[illegible]ng animals, possibly, new coal de[illegible]s, new ore supplies; no one is sure [illegible] what until explorations are made. [illegible]ka was considered a barren region [illegible] its vast mineral and other resources [illegible] discovered. Similarly we may be [illegible]aken in our concept of north-polar [illegible]ions and of the south-polar continent. [illegible] Rear-Admiral Peary's ideas take shape [illegible]irplanes will find out.

When Airplanes Whizz Over the Pole

"In the very near future," says Rear-Admiral Robert E. Peary in a new book, "Secrets of Polar Travel," "the biting air above both the earth's poles will be stirred by whirring airplane propellers"

A Phonograph for Lazy People. It Changes Its Own Records

A GLORIFIED phonograph has been patented by a young man in California. His phonograph will do everything but go out into the dining-room and mix a cocktail when the music is over.

Harry Scott, the inventor, gives the fruit of eight painstaking years to indolent humanity. His phonograph numbers among its achievements the ability to play both disk and flat records. But its forte is the cylinder. It will play cylinder records, one after another, without re-winding, without changing, indeed, without any more effort than sitting down in an easy chair and listening.


This phonograph does everything but provide the smokes and drinks for the company

Cylinder records are played in a vertical position. Eight cylinders are placed in pockets that permit the upper rim to project about one inch. The pockets are cut into a revolving platform. When one cylinder is finished, the table automatically revolves until the next cylinder is under the reproducing needle.

The operation is continuous. A button is pushed to start an electric motor. The same push button stops the performance. If intermissions between selections are desired, alternate records are removed. For dancing parties, it is obvious that the automatic changing mechanism has advantages.

Six patents have already been issued upon this apparatus. Besides accomplishing the feats outlined above, many little niceties have been incorporated. For example, when the lid is raised a frosted electric lamp flashes on. Lowering the lid switches off the lamp. Besides this, a small brush has been incorporated which follows the needle, carefully cleaning every record as it is being played. Another feature is an automatic oiling device which deposits one drop of oil in every important bearing at the necessary intervals. Small storage vaults for records, making the disks convenient of access, round out an apparatus that gives us an inkling of what the phonograph of one hundred years from to-day may resemble. At any rate most of us are innately lazy, so we at least think kindly of this inventor.

The Desert Dry? Read This

WOULD you believe that the air in an average schoolroom is drier than the air in the deserts? That is what recent tests indicated. However, there is nothing to be alarmed over, as the drying power of air does not depend so much on its humidity as on its being in motion. An interesting illustration of this is furnished by the fact that the air in a room which is fan ventilated and artificially humidified has greater drying power than the air in a naturally ventilated and humidified room.

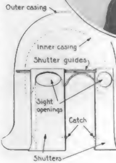
"Come Seven! Come Eleven." Honest Deal Always

HONESTY in the manipulation of the dice is assured by a new dice box provided with a conical bottom and spiral ridges around the inside walls, as these make it impossible for the player to prevent the dice from turning over at every throw. The box is moulded from one piece of tough but flexible leather so that dice with the finest surfaces are not injured. The box is also practically untearable and unbreakable and outwears the average dice cup.


Here is an anomaly —an honest dice box. Is it possible?

How Would You Like to Wear a Bell-Shaped Helmet With Shutters?

CLARENCE L. STOCKS, of Blue Ridge, Georgia, has invented a helmet which offers complete protection to a soldier's head. It is bell-shaped and consists of an outer and inner casing, the latter having attached to its interior two head bands to conform with the shape of the head. The helmet has flaring lower edges to protect the neck as well as the head. Two sight openings are provided in front for the eyes. However, the inventor has not neglected the wearer's nose and mouth. Two shutters fit snugly against the sight openings and are hinged to the outer casing so that they may be opened or closed as desired. U-shaped springs between the inner and outer casings are placed so as to reduce the shock from shell-splinters or bullets which may hit the helmet. The objection to this helmet would seem to be the limiting of the wearer's vision, for how can a man see quickly all around him through two small holes? It would certainly be very hot too.



The bell-shaped helmet is provided with shutters to afford full protection

The diagram gives the details of the new protecting helmet

The Amazing Nanny. Her Milk Is Worth Fifty Cents a Quart

"BUT, Doctor, I have tried everything!" When some anxious mother whose baby is suffering from under-feeding makes this rash statement, the medical gentleman appealed to is likely to smile encouragingly and ask, "What about goat's milk?"

Then in reply to the woman's curious or repelled expression he may explain the interesting experiments which took place at the Michael Reese Hospital in Chicago, where sick babies were fed on goat's milk with astonishingly good results.

So prepare to appreciate poor, maligned "Nanny." Here is a list of her virtues compiled by Mrs. Jessie H. Watson, who has a goat farm at Wycombe, Pa., and considers herself qualified to testify.

Nanny has brought back to health, not only many sick babies, but adults afflicted with indigestion or tuberculosis. She is the healthiest domestic animal in the world. She is non-tubercular and gives pure milk, of rich quality and fine flavor. She can be kept in much smaller quarters than a cow requires.

Contrary to popular belief, the goat is a tractable animal, easily tended by a woman or even by a child

The One-Man Animal Ambulance and What It Does

AN ambulance for animals which was recently placed into active service by the Humane Animal Commission of Los Angeles, California, presents many novel and ingenious features. The ambulance body is mounted on a motor truck, with the driver's seat in front, and the enclosure for the animal patients in the rear. Both parts are protected by a roof. The rear enclosure has side doors and a rear door, hinged at the bottom, so as to form, when let down, inclined gangways, reaching the ground. The sides of the enclosure are heavily padded and the floor consists of a removable platform which rests on rollers and which is also padded.

1. Shows end door and standing horse
2. Shows side door for walking animals

. The platform is removed from the car and rolled alongside the prostrate animal. A rope is attached to the feet and, by means of a windlass worked by the motor, the animal is pulled upon the platform. Then, by the same method, the platform is rolled into the car. The windlass will also raise the rear door after the loading is completed. Animals able to walk, are led into the enclosure by the rear incline and leave the ambulance at their destination through the side door. One man can operate the ambulance, and the animals are carried in comparative comfort.

Roller platform being drawn, with its burden, into the car by the power windlass

Wood That Gives a Wonderful Fluorescence to Water

RECENT investigations have led to the rediscovery of two species of trees known centuries ago, but never definitely identified and subsequently forgotten, the wood of which gives to water a most remarkable fluorescence. One of the trees with the scientific name *Eysenhardtia, polystachya*, is a small bushlike tree with small, fragrant white blossoms and is found in Mexico, while the other, *Pterocarpus indicus*, known to the natives under the name of *narra* or *naga*, is a giant tree growing in the forests of the Philippine Islands. Chips of the wood of these trees, placed in water over night, cause it to become highly fluorescent and to display, according to the degree of illumination, a wonderful variety of opalescent colors, ranging from golden yellow and rich red through green to a deep blue. The fluorescence becomes particularly pronounced under the influence of the ultraviolet rays of the spectrum. The active substance contained in the wood of the two trees which causes the fluorescence has not yet been determined or isolated. The first mention of this remarkable wood is found in a book printed in Seville in 1574. It was there spoken of as being a native of Mexico and was called *lignum nephriticum.*

Detecting Glucose in Jellies, Jams, and Kindred Confections

GLUCOSE in fruit preserves may be discovered as follows:

In the case of jelly a teaspoonful should be dissolved in two tablespoonfuls of alcohol contained in a glass vessel. In the case of jam or marmalade the same process is carried out, but it is necessary to filter off the solid matter by running the mixture through a piece of muslin. Allow the solution to become perfectly cool, and then add an equal volume, or a little more, of strong alcohol. If glucose is present a dense white precipitate slowly settles down. Where no glucose has been employed there is no precipitate, save, in some cases, a very trifling sediment of proteid matter which, however, is so small that it could not possibly be mistaken for the sediment which glucose produces. The last-named is not particularly harmful in itself, but it is very frequently used as an adulterant in supposedly pure preserves for extra profit.

This simple apparatus will enable you to detect the presence of glucose in jam and marmalade

Chain Your Automobile to a Hydrant If the Electric Lock Doesn't Hold

ADMITTEDLY, the stealing of automobiles has become a serious problem. John F. Hendrickson of Wollaston, Mass., would prevent it by installing on every car an electric lock. This shuts off ignition circuits, current to the starting motor, and also locks the steering wheel when the owner withdraws the key and leaves the machine.

The circuits are too complicated to reproduce in detail here, and also vary with the make of car. The contacts inside the electric lock are so arranged that, by resetting certain pins, at any time it is possible to change the combination and thus foil the thieving proclivities of a chauffeur or other person who has almost familiarized himself with the system and is about to make a get-away with the car. Elaborate auxiliary devices are also provided to prevent unauthorized removal of any parts of the system in an attempt to get at the inner wiring.

Contrivances such as this, though commendable in their effort, practically all fall down because the feat is almost impossible. It is always possible to get at inner wiring in one way or another, and a knowing thief can soon devise impromptu wiring that will work. It is an axiom among burglars that the simplest and rustiest old locks are the most baffing. About the only way effectively to make an automobile stay in the place where you left it, against all comers, is to insert a long piece of railroad rail between the spokes of the hind wheels and chain it to a convenient hydrant—and then there would be sure to be a fire.

A complicated electric lock, designed to thwart attempts to steal an automobile

Spotting the Submarine From the Observation Balloon

THE man who, in his youth was adept at climbing ropes, performing on the trapeze and in indulging in other acrobatic feats finds limitless field for the use of his skill in this war. Here we have a French observation-balloonist sliding down a rope from his basket to a steamer that has been towing him around. A hard day's work has just been completed. He has been looking for submarines in English waters, directing the work of destroyers, and otherwise acting as a lookout. It is climb around in rigging adjusting apparatus, slide down ropes, strain eyes out over wide stretches of water, and operate delicate wireless apparatus all day long. The responsibility and strain are great, and it needs a man in tip-top condition and with a natural aptitude to do the job.

© Underwood and Underwood

Observer slides down after looking all day from a kite balloon for submarines and other hostile craft

Both armies and navies of practically all the countries at war use observation balloons in great number. They are indispensable for finding out what opposing forces are doing. The side temporarily without balloons is blind. The observer's job is one of the least spectacular and most important in the whole of the service, and requires men fit in every way.

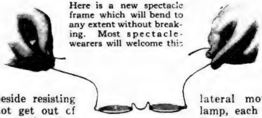
Using a Maxim Silencer as an Automobile Muffler

IF, said one western manufacturer, the Maxim silencer will deaden the sound of a gun explosion, why would it not deaden the noise of the automobile engine's exhaust? Convinced of the soundness of this argument, the manufacturer has just placed on the market the Maxim muffler shown in the accompanying illustration. While cylindrical in shape like other mufflers, the new type has no baffle plates or perforated disks through which the gas must be forced, so that the muffler is eventually torn apart through the direct impinging pressure of the gases, to the accompaniment of rattles, which are the automobilist's bane. Instead, it has two end plates with a series of non-concentric tubes between. As shown, each tube has an overlapping opening into the one of the next larger diameter through which the gas may expand gradually on its way from one end of the muffler to the other. As everyone is aware, it is the sudden expansion of the hot gases under pressure, to the atmospheric pressure which produces the noise. The object of a silencer is to allow them to expand so gradually that when they reach the outside aperture they are at atmospheric pressure.

New silencer for automobile engines on principle of Maxim silencer for guns

A Side-Piece for Eye Glasses Which Will Not Break

ONE of the new devices for glasses, of interest to the person who uses the style with side-pieces, is a very flexible side-piece which does not break even when it is subjected to considerable bending. The new side-piece, beside resisting breaking, does not get out of shape. It is constructed so that it has a flat side which tapers gracefully to the end piece. This flat side gives it springiness, so that it returns to its proper position after being bent in or out. The construction of the side-pieces also keeps the glasses from getting out of alignment.



Here is a new spectacle frame which will bend to any extent without breaking. Most spectacle-wearers will welcome this

All wearers of spectacles will appreciate this innovation. Everyone knows the ease with which the ordinary spectacle frame can be damaged, and such breakages, if they come at all frequently, are very expensive. Outdoor workers, in particular, will welcome a spectacle frame that is unbreakable. It is not only the frame that is likely to break, but, on rimless glasses, the lenses may go. A frame which will take up any strain to which it may be subjected will save them.

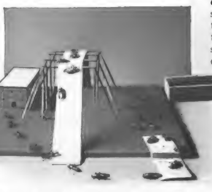
Focusing the Locomotive Headlight With a New Adjusting Device

THE electric headlight of a locomotive can be focused with a very high degree of precision by means of an improved micrometer focusing device. It provides for vertical, horizontal, and lateral movements of the lamp, each independently of the other, so that compensation may be made for non-symmetrical reflector curves and irregularities of lamp manufacture. While a high degree of accuracy is possible, the adjustments may be made by a person inexperienced in the handling of instruments of great precision. Each moving part is spring cushioned against the wearing effect of locomotive vibration. The device may be also used when an oil or gas burning headlight is converted to an electric light, as any experienced mechanic can install it.

The focusing device described above permits of exceedingly fine optical adjustment of locomotive headlights, and the penetrating power is very considerably increased by its use

"Educated" Ants the Latest Thing in Animal Training

THERE is a great fascination to many persons in the difficult task of training animals and it is remarkable how wonderful has been the success of some trainers, especially of animals noted for their high intelligence. But, the efforts of the training enthusiasts have not been altogether confined to the higher animals; they have included some of the less gifted creatures, and have even interested themselves in the pesky flea.



Coughlin's troupe of performing ants. The commands must be spoken in Antese, we anticipate

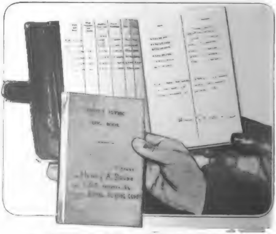
The accompanying picture shows that even ants have been used for pedagogic experiments. John W. Coughlin, of Ellsworth, Me., succeeded in training these Madagascar ants to perform certain military movements and other tricks which are said to be remarkable. It is not reported which language the trainer used in giving his commands; at all events the insects must have understood it, for they obeyed the commands.

The Air Pilot's Flying Log Book and How It Is Used

YOU have heard of ship's log books, but here is a new kind of log—a small, tan, leather-covered book, seven and one-quarter inches long and four and three-quarters inches wide. On the cover is the title "Pilot's Flying Log Book." Every airman in the British Royal Flying Corps has one of these books issued to him the day he takes his first lesson in piloting an airplane. Until he is honorably discharged or killed in action he must enter a record of each flight he makes. At the end of each week the number of hours in the air and also the number of landings made are totaled and signed by the officer commanding the squadron to which the airman is attached, one of which is clearly shown in the illustration. Note that this particular page is signed by the ex-dancer, Captain Vernon Castle, Commanding No. 84 Canadian Training Squadron.

The first entry in this log book gives one an idea of the dangers of the air. Engine trouble forced the pilot to make a landing. A forced landing is difficult and dangerous, but as there is no mention of damage, it must have been made safely.

It is said that truth is stranger than fiction and if all the reports that filter through and reach us through the medium of the newspapers are only half true, the log of an airman must be a masterpiece. Jules Verne wrote strange stories, but present-day facts leave even them behind.



An airman's log book. Each flight is recorded and each book must be almost an epic in itself

The Motorcycle as a Valuable Asset in War Operations

FROM the arrival of the British Expeditionary Force in Belgium in the late summer of 1914 down to the present time, the motorcycle has steadily gained in importance in different branches of the military service. Its use has not been restricted to the Allied armies. The best authorities place the number of motorcycles employed by the armies of the Central Powers, at the time of the Battle of the Marne, at 18,000. The British had at least 40,000 in service in the Spring of 1915, while the French had about 11,000. The Italian forces, up to the present, have 10,000 according to recent estimates.

Japanese motor vehicle experts study our motorcycle machine gun units and methods

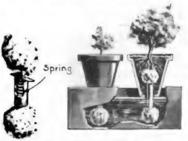
It has been figured that more than 750,000 motorcycles have been in use for military purposes by the belligerent powers since July, 1914. This does not include those at present in the United States Army services, for prior to our entrance in the Great War, the American Army did not have more than perhaps 150 machines in all.

Before the era of trench warfare on a large scale, the greater number of motorcycles in use were for despatch riding. By reason of its readiness for use at a moment's notice and its ability to thread its way among the heavy traffic behind the lines, the motorcycle superseded all other means employed for carrying despatches between headquarters, often long distances apart.

Another important use of the motorcycle in war is that of convoying supply trains from base to distributing stations along the front. The flexibility of the motorcycle makes it particularly valuable for such work. Motorcycles have also been used in considerable numbers, to convey picked riflemen to points on the front where reinforcements are needed, and whole battalions are sometimes transported in this manner.

Supplying Water to the Thirsty Rootlets of Potted Plants

THE device illustrated, once installed, will reduce to an absolute minimum the work of keeping the potted plants supplied with the required amount of water. It consists, in its main feature, of small tubes containing sponge or some other water-absorbing material, which protrudes from the tube at both ends. These tubes are inserted with their upper end through the hole in the bottom of the flower pots, so that the sponge reaches well up into the soil surrounding the roots, while the lower part of the tube with its corresponding sponge end goes through the cover of the pan or receptacle, upon which the pots are arranged, and reaches into the water with which the pan is filled.



This little arrangement will save much trouble if you grow plants

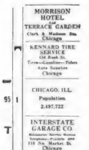
Capillary attraction carries the water up the tubes and the plants are thus thoroughly irrigated.

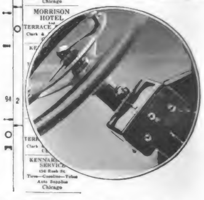
The Automobilist's Automatic Pathfinder on the Steering Column

EVERYONE who has ever toured to any extent over unfamiliar roads in an automobile, knows how inconvenient it is to have to stop every few miles and compare the reading of his speedometer with the distances as given in his route book. Even if a member of the party sat on the front seat and called off the mileage readings and the landmarks, it is often necessary to slow down or turn back to find one's bearings.

All these difficulties have been eliminated by means of an automatic route book which is mounted on the steering column of the car directly under the steering-wheel where the driver can look at it without taking his hands off the wheel. The new type of book has no pages to turn or no places to find. It consists of a small metal box carrying a tape on which is printed for any particular route, the turns of travel as indicated by arrows, and other symbols for steam and electric railways, dangerous curves, bridges, garages and hotels. The tape also supplies information on road conditions, traffic laws, and other historical points of interest. A full mile of travel is always visible on the tape and in this way prepares the driver in advance for any unusual or dangerous road conditions, crossings, steep hills, etc.

A separate tape is required for each route. All that the driver has to do is to start the tape at the point indicated. The tape mechanically unwinds from a roll in one end of the case and winds up on a similar roll the other, the movement being provided by a flexible shaft geared to either front wheel in much the same manner as a speedometer.





This is a sample of the tape and the indicator on the steering column that does away with cumbersome route books

Electricians Should Wear Straw Hats While at Work

A SUGGESTION has recently been made by a prominent engineer, that all persons employed in and around electrical stations should wear straw hats with stiff brims all the year round while at work. Straw is a better insulator than felt and the stiffness of the straw gives an additional advantage, as it gives more emphatic warning to the wearer of the hat when he comes in contact with a wire or apparatus carrying electricity of high tension. It may seem ridiculous to wear a straw hat in zero weather, but—safety first!

And Now We Wash Ourselves in the By-products of Garbage

NEW York city's plant on Staten Island for the reclamation of garbage produces the necessary fat for ten million cakes of soap yearly, and also the nitrogen and glycerin for the manufacture of seven hundred thousand pounds of high explosive. In addition to this, much phosphoric acid and potash are reclaimed and sold for fertilizers. This is effected by the so-called Cobwell process.

Novel Application of the Service Flag Idea on a Girl's Belt

ONE of the latest applications of the service flag idea was displayed recently in public by Miss Evelyn Grieg of New York and attracted favorable attention. Upon her broad patent leather belt she displayed four stars in token of the patriotic devotion of four members of her immediate family who have joined up to help make the world safe for democracy.

© Underwood and Underwood

Belt advertising the number of relatives one has in the services

Orange Tree Made Riverside Rich

IN 1872, United States Consul to Bahia, Brazil, Mr. W. F. Judson, was told by the natives that some sixty miles inland, up the Amazon, were native orange trees bearing fruit without seeds. Accordingly he sent natives after tree shoots and some of the fruit. The shoots were packed in moss and clay and sent to Washington. They were set out by the Agricultural Department, but attracted little attention until the next year, when Horatio Tibbetts, of Riverside, California, took the surviving four shoots to his home and planted them. One died and another was eaten up by a cow. At the end of five years the two surviving trees bore sixteen handsome seedless oranges. Next year the oranges were even better, and the trees bore about a box of the fruit.

From that time on the cultivation of the seedless oranges about Riverside progressed rapidly. As there were no seeds to raise the trees from, it was found necessary to graft buds of the seedless trees into seedling trees.

Riverside has grown from a small village to a town of fifteen thousand people, and has twenty thousand acres devoted to the cultivation of navel oranges. It is the greatest orange producing locality in the world. The two original trees were fenced about and carefully guarded lest harm should come to them, and they are now enjoying a green old age. One of them is shown herewith.

The grandfather of navel oranges. One of the two original seedless orange trees

Heavy Artillery Is the Correct Weapon for Shooting Canaries

DURING some recent mining operations beneath the German trenches, some canaries were, as usual, taken into the excavation to indicate the presence of noxious gases. One of these little songsters escaped and flew to the middle of "No Man's Land," where he perched on a shrub and began to sing. Fearful that the Germans would notice him and so discover that mining operations were going on, the British opened fire on him, but he seemed to bear a charmed life. The sharpshooters tried to "get" him, and the rank and file took pot-shots at him, but still the liquid notes flowed over the landscape. Finally, in desperation, he was fired on with trench guns and a well-placed shell obliterated bird and bush and song.

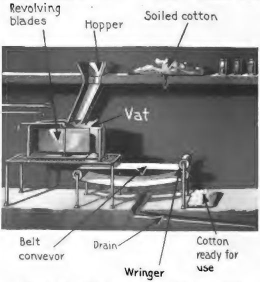
Using Absorbent Cotton Over Again

France has not enough cotton for her wounds, so a chemist invents a cotton rejuvenator to cleanse the old

MAKING use of absorbent cotton that has been soiled by a wound, no matter how sterile it may become by any process, seems repulsive. But, to paraphrase General Sherman, war is *war*, and a French chemist, B. Villey, has undertaken, successfully, to supply his country's wants.

Impressed by the huge demands, the demands that could not be met, for absorbent cotton for wound dressing, Villey set about rejuvenating absorbent cotton which had been used and discarded.

It was a colossal task. Killing the germs in used cotton was the smallest part of it. Absorbent cotton must have "life." It must be springy; it must *absorb*. He developed one type of machine to do this work, and then another. Popular opinion was against him. It wa[illegible]-hill struggle. But at last [illegible] He had won! He had [illegible] making old cotton [illegible] fine, white [illegible] *absorbed.* [illegible] seize upon [illegible] Did they [illegible] *Croix de* [illegible] proposal [illegible]artment to [illegible]holding the [illegible] someone noticed it. The cost of rejuvenated cotton was compared with the cost of new cotton and found to be about three to one, in favor of rejuvenated cotton. The two were compared physically. Then came the hoped-for gush of enthusiasm.



Machine for Reclaiming Soiled Absorbent Cotton

The soiled cotton is dumped into the hopper and passes down into the vat. Here it is treated with disinfectant chemicals, being at the same time agitated by the revolving blades. After this it is washed and is again treated, this time with soda solution to extract the fat and grease. Finally it is restored to its original whiteness in a bath of hypochloride of lime. The clean cotton is ejected on the endless belt. $1,000,000 is saved annually

Villey's cotton rejuvenator is quite simple. Any hospital can install and operate the machine in a modified form. Many hospitals have done so. Villey will modestly tell you that the demand exceeds his expectations.

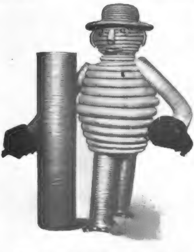
Soiled cotton is dropped down a chute into a large vat where it undergoes several treatments. First, all germs are killed and all poisonous matter removed by chemicals and washing. An objectionable element still remains. This is grease, or fat, which has been drawn from the wound, and takes the form of a sheath. It is boiled out in a solution of soda.

The mass is now whirled about by revolving blades or paddles, not unlike the way dirty clothes are whirled about in a washing-machine. Well washed and drained, the cotton is restored to its original whiteness in a bath of hypochloride of lime. Repeated washings and sterilizings follow and it is at last dried. The process saves $1,000,000 annually.

The Metal Hose Man and How He Was Manufactured

At the recent automobile show in New York, an exhibit of a Newark manufacturing company attracted much attention. Its exhibit was a man-shaped figure composed entirely of specimens of its various kinds of hose.

The height of the figure was three feet. In its right arm it held a section of big tubing, five inches inside diameter, interlocked. The hat was built from smaller tubing used for wire covering. The body was made of carbureter hose packed with asbestos or a heat-proof fiber, and employed by automobile manufacturers. The feet and hands were made from exhaust stoves or hoods. Ears and mouth were oil conveyers which shoot greasy compounds, kerosene and cutting oils upon machine work for rapid and accurate production. The legs were of pressure hose. Small electric lights formed the eyes.



This quaint figure is made entirely from flexible metal hose and fittings

What a Woodpile! It's Three Hundred Feet High

PROBABLY the biggest woodpile on record, shown in the accompanying picture, is to be found at Berlin, New Hampshire, the center of an important paper-manufacturing district. The pile, which forms a respectable hill, plainly visible from a great distance, is composed of more than seventy-five thousand cords of wood which are to be made into paper.

An idea of the size of this pile may be gained from the fact that its highest point is nearly three hundred feet above the ground, while its extreme length is more than one thousand feet, or nearly a quarter of a mile. Some statistician has figured out that, if these logs were split up into cord wood and laid in a straight line, they would reach nearly twice around the earth. The potential number of miles of newspaper it contains must be fabulous.

This is not a slag-heap, but a great pile of logs of spruce and other pulp-wood, which is destined eventually to arrive at your breakfast-table in the form of newspaper

New Method of Mounting Unbreakable Watch Crystals

TO overcome the inevitable loosening of the crystal in watches suitable for soldiers' wear one manufacturer clinches the rim into the crystal as shown in the accompanying illustration. The crystal employed is likewise made of a compound that will not burn, thus forming an ideal device for wear in the open or where the watch is liable to receive hard knocks.

This crystal is clamped into the watch rim to prevent loosening

Acetylene Trench Gun—It's a Great Thrower of Shells

ACETYLENE gas does not work well as an engine fuel. It is too explosive. However, a Paris inventor, R. A. Brèvaire, would turn this to good use in a trench-gun.

The lower part of his machine consists of a chamber into which air is forced under pressure, or sucked in by the rush of an outgoing shell. Having thus filled the chamber with air, the operator next admits a small quantity of acetylene gas by means of a valve. Air and the gas intermingle forming a highly explosive mixture. This is set off at will by means of a spark plug and a suitable coil. Shells are inserted in the gun by dropping them through the muzzle, rear-end foremost. If the gun-barrel is unrifled, wings at the base of the shell make it spin and fly true. A sound-deadening chamber is fastened to the outer end of the gun; it is built on the principle of an automobile muffler.

This gun is new in being the first trench gun to use gas as an explosive.

Poisonous and Harmless Mushrooms Difficult to Distinguish

IN a special bulletin published by the U. S. Department of Agriculture special emphasis is laid upon the fact that there is no simple test for distinguishing between edible and poisonous mushrooms. Many of the alleged distinguishing marks used by farmers, dealers and purchasers of mushrooms to differentiate between edible and poisonous mushrooms are considered by the experts of the Department entirely fallacious or too unreliable to be used with safety. The only safe mushrooms to eat are those gathered by a collector who knows exactly what he is doing. Only such mushrooms should be picked as are known to be non-poisonous and all mushrooms, which in any way differ from the known type of edible varieties should be left severely alone. Every season there are numerous fatalities from eating the poisonous varieties.

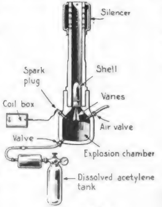
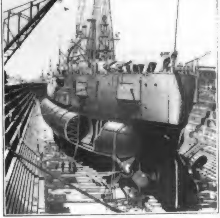


Diagram and illustration of a new acetylene trench mortar, fitted with silencer and recoil mechanism. Acetylene is too explosive for automobiles, but this is a virtue in guns

Torpedo-Proofing Ships with Air Tanks

Air-cushions to run along sides of ship are proposed as a protection against torpedoes

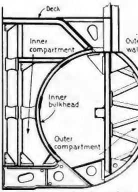
SINCE the beginning of the Great War, and particularly since Germany adopted the submarine policy, the brains and ingenuity of inventors of all classes and ratings have been directed toward finding some means of counteracting the destructive effects of the torpedo. Many expedients have been suggested, ranging all the way from extremely feasible propositions to the wildest vaporings. The following article deals with one of the more probable ones.


A cruiser in dry-dock, showing how the air-chambers are attached below the waterline

Hudson Maxim, who has, himself, suggested a method for torpedo-proofing ships in which he makes use of the principle of the "gun silencer," states that the explosive charge in the war-head of a modern torpedo consists of about four cubic feet of T.N.T. (tri-nitro-toluol). When the detonator inside the charge is fired the T.N.T. explodes, and within less than the twenty-thousandth part of a second the four cubic feet of explosive are transformed into 40,000 cubic feet of gases, having a temperature of about 5,000 degrees F. The mass of water surrounding the explosive offers a greater resistance to the sudden expansion of the gases than the wall of the ship and as the expansion follows the line of least resistance, the wall of the ship is crushed and the expanding gases enter into the body of the ship with destructive violence.

With this picture of a torpedo's effect before us we are prepared to understand the invention of Thomas G. O. Thurston, of London, England, recently patented in the United States. Thurston, taking the terrific expansion of the gases generated by modern explosives into account, seeks to provide a system of large resistance and expansion chambers which act like an air-cushion by which the force of the inrushing gases is smothered and robbed, to a great extent, of its destructive potentiality.

The inventor proposes to construct these shock-absorbing chambers along the sides of the ship for a suitable distance forward and aft. He suggests various forms, all showing a decided bulging outward, beyond the normal contour of the ship. The back of these bulging outer chambers, formed by a suitably stiffened bulkhead or inner framework, separates the outer chamber from the inner compartment, which provides the final and strongest resistance to the expanding gases. This inner compartment has a strongly braced back curving inward toward the interior of the ship and the air contained i it is intended to act as ai additional cushion.

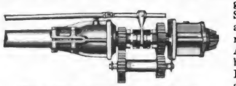


Diagrammatic view of the latest torpedo protection

Giving Fords a Greater Pulling Power for Heavy Loads

ALTHOUGH in passenger car service the Ford car generally has adequate pulling power for all kinds of hills, there are times when it is used as a delivery truck that still greater power at low speeds would be advantageous.

This device is inserted in the regular Ford driving shaft just forward of the rear axle and consists of a small case enclosing a series of gears which are always in mesh. This constant-mesh feature distinguishes the invention from the gears of the average passenger car in which each gear is out of mesh except when transmitting power. In the device illustrated the gears, while always in mesh and turning, transmit the power only when they are locked to the shaft by means of jaw clutches. These can be slid into mesh with much less chance of stripping than the gears themselves.



This auxiliary gearset gives a Ford more reserve power on hills or with heavy loads

The Ford car is operated as usual, except when additional gear driving ratios are required. Then the auxiliary gearset control is operated to give three additional ratios, one in low, one in reverse and the third in intermediate speed, thus giving the engine almost double the flexibility.

The Motion-Picture Scene-Shifter Enters the War

POOR Fritz will never again believe what he sees, or believe what he thinks he sees. "When is a tree not a tree," is going to become a more terrifying conundrum to him every day. This is the reason why:—Moving picture men are going into the "camouflage" business.

Some of the recruits of a newly organized United States Army corps are experienced motion picture men. A full company has been raised in the Los Angeles studios alone. Another company stands ready to be enrolled. The men are eager to use their skill to "make up" imitation cannons, tanks, machine guns and other grim actors for their parts at the Front.

A recent demonstration, held in one of the great Los Angeles studios, revealed the possibilities of "camouflage." The wizards of illusion raised a village in the twinkling of an eye; tore it down with equal dexterity, and in an incredibly short time substituted a startlingly perfect "camouflage" forest. The fairy-tales of our youth, in which genii and fairies raised and removed castles by magic, seem to bid fair to come true in these days of seeming miracles.

Two masterpieces in camouflage. The first is a sham "gun." In the second, village, gun, smoke, and all, are, for practical purposes, "of the stuff that dreams are made of"

A Sweet Potato Digger That Lifts the Potatoes and Cuts the Vine

A NOVEL potato digger for sweet potatoes, invented by Oliver Cordrey, of Laurel, Delaware, digs deep under the potatoes and lifts them out, leaving the ground level with the vines on top for a cover through the winter, instead of turning the vines under a furrow as a plow would do. The ground is left in condition for raising better corn the next season where that crop is used in rotation with sweet potatoes.

The machine has a pair of runners arranged at opposite sides of the beam, which each carry a small cultivator disk. These runners are adjustable vertically. Back of the runners is a scoop, having upwardly extending rear arms. This scoop is adjustably mounted so that it may be tilted relatively to the beam.

So long as farmers used the old plow for turning out their sweet potatoes they could not raise corn the next year. The vines were covered at the bottom of the furrow and the subsoil turned up to the winds of winter, since it was necessary to plow deep to avoid cutting the potatoes. The new digger obviates this and cuts the vines as it digs, thus performing what formerly were separate operations. The resulting saving in labor is from $5 to $10 per acre—figured on pre-war prices. The machine is of light draft, simple in construction as compared with most machines designed for potato digging, and is self guiding after being started in a row.

As the digger is comparatively inexpensive, and the saving effected is very considerable this should prove very popular, particularly with small truck farmers. The fact that the machine can be run by unskilled labor counts.


A potato-digger constructed to lift out the potatoes without turning over the earth like the old plow


The little apparatus shown weans a calf without separating him from his mother

An Effective and Humane Method of Weaning a Calf

RUSTIC ingenuity has devised a number of contrivances to prevent calves from nursing while they are in the same stable or the same pasture with their mothers, but most of these devices are extremely clumsy and awkward. The device shown in the picture avoids most of the objectionable features of the older appliances. The upper part is fastened to the nose of the calf by a hinged clamp and causes neither pain nor injury to the animal. The lower part, which is hinged to the nose part and swings freely, makes it impossible for the calf to nurse, although it does not prevent it from grazing.

This obviates the necessity for keeping the calf confined.

"Mothers" for Airplanes at Sea

How the Atlantic Ocean or the war zones can be protected with relays of seaplanes

By A. L. Aldey

AERIAL convoys for transports and merchant vessels crossing the high seas, aerial protection for harbors, aerial raiding bases for sea attacks, and transoceanic aerial patrol service—by these uses of air-craft might perhaps be given the vital blow to the German submarine.

Why not, though, airplane bases at sea? And if at sea, why not all the way across the Atlantic? Why not airplane stations in and near harbors, where the craft can be despatched, received, overhauled, and refitted? Why not, in other words, not only a maximum of aerial coast defense but an open sea lane, patrolled day and night by planes?

Such a cross-sea lane is not as yet needed, perhaps. But the lane could be extended from English and continental shores as far as required to give ample protection within the operating zone of the German submarines.

What I propose here is the adaptation of a German idea—that of the "mother ship" for submersibles—to the airplane, at the same time retaining the protective and repair value for submarines and destroyers embodied in the Teuton ship; with the further expansion of the use of these double vessels on the open sea where they can be utilized as starting and receiving points for aerial patrols, for light ships, for relay wireless stations, for defense points against torpedo raids.

Take then, by way of summary of this plan, two separate hulls, so connected by superstructure as to form one boat with two bottoms. Two sets of engines and double rudders would provide for the handling of this double-hull ship.

The superstructure above these hulls may be most briefly described as a "platform," a deck of extreme width and length, from which air craft could be launched and, in some instances, received.

Between the hulls is a natural harbor, the water of which is made calm by the lowering of end gates to keep out the waves. From beneath the upper "platform," or deck, hangs a false deck which may be lowered into the water. This lowered deck and the end gates form, with the hulls, a huge tank into which hydro-airplanes can descend, and by means of which they may be elevated to the upper deck for overhauling. Similarly submersibles, destroyers, and small water craft can be driven into this protective space and taken out of water for repairs and scraping.

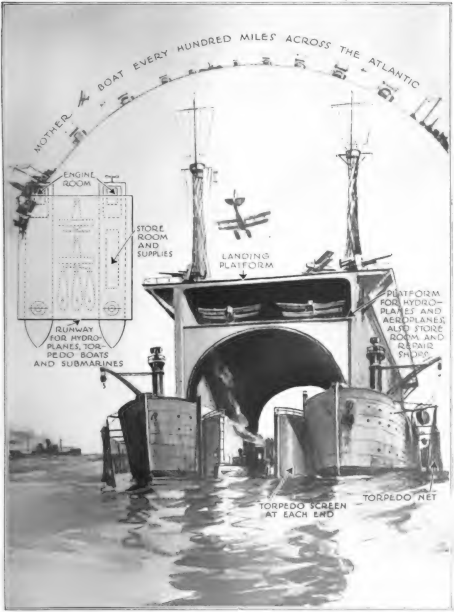
The stationing of such "mother ships" at intervals of, say, a hundred miles all the way across the Atlantic would provide an open lane for transports and merchantmen. One hundred miles an hour may be given as an average speed, all weathers and models considered, for an airplane. These stations, then, would be but an hour apart by air route. At no time would any airplane patrolling from one station to another be more than half an hour's ride from another.

Constant patrolling by aerial routes from one station to another would keep the sea clear of under-water raiders. Communication would be so rapid, discernment so easy, that the submarine would be less deadly than it has proven to be. The air could be kept filled with the flying scouts, passing from station to station, one hundred miles and return, with communication maintained by wireless, not only between airplane and floating harbor, but between the stations themselves.

Once a periscope has been sighted anywhere within radius of the sea lane, general knowledge of it is known; and from the "mother ships" debouch a fleet of destroyers.

For the protection of the "mother ships" torpedo nets would be provided. Besides there are the accompanying destroyers, the "mother ship's" own heavy artillery and munitions. It would be a rash submersible navigator who would invade the precincts of such a lane.

Patrolling the Ocean with Sea Planes



What a "Mother Ship," as Suggested in Our Article, Would Look Like

In the accompanying article the writer propounds a scheme for placing one of these vessels at intervals of a hundred miles, all the way across the Atlantic. They would be fully equipped with spare parts and supplies for airplanes and submarines. They would also carry wireless apparatus, and would, in fact, be fully equipped naval bases in miniature. They would repair seacraft and airplanes and would relay wireless messages, being official stations. They themselves would be protected by torpedo nets, heavy guns, and fleets of destroyers, for which they would form a base. In fact, their use in every direction is limited only by their size

This bicycle track, properly banked and oiled, was designed and built by a number of resourceful Los Angeles boys

"Let's Build a Bicycle Track"—And They Did

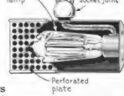
AN ingenious crowd of boys in Los Angeles have made a very good bicycle track on a vacant lot. One of the boys' fathers was a contractor and this lad superintended operations. The track was first laid out with chalk and stakes, and then the bunch turned to and did the digging. They soon had it banked up and smoothed off. Then they watered it, and oiled it with waste "slag" oil which they carried from a nearby oil well in tin cans.

How to Keep the Windshield Clear by Heat

TWO Chicago inventors have recently patented a device for keeping the windshield of an automobile or the window glass in front of a trolley motorman clear by means of an electric incandescent bulb. The heat generated by this bulb is sufficient to heat the glass so that snow, sleet, moisture or ice will at once be turned into water and run off or dry off, thereby enabling the man behind it to see through without difficulty.

Although the same in principle, the device for the automobile differs slightly from that for the trolley car. In each there is a semi-cylindrical casing enclosing the incandescent lamp and a bracket supporting the casing to [illegible] be swung up out of the way when not in use. The uncylindrical portion of the casing consists of a flat perforated metal surface which is in contact with the glass of the windshield or car window.

The automobile unit has a bracket which is slipped over the wood or metal edging on the top glass of the windshield, in the car device, the bracket arm is pivoted inside the bottom of a box with a hinged door so that the arm and casing enclosing the lamp may be swung about its pivot into the box and the door closed. In each case, small coil springs are employed to keep the perforated metal part of the casing in contact with the glass so that the heat radiated by the bulb and reflected by the back of the casing cannot pass off without first going through the glass and heating it sufficiently to dry it.



Every automobilist knows how uncomfortable, and even dangerous, a frosted or misty windshield is, and any device that will obviate these conditions is welcome. This device has an advantage over scrapers and cleaners in that it requires no repeated manipulation or attention.

An incandescent lamp in a reflector melts the ice and moisture off the windshield, giving clear vision

Caging the Airplane Propeller in Case He Gets Too Wild

THE propeller of a modern flying machine rotates at the rate of about fifteen hundred revolutions a minute. It is mounted directly on the shaft of the powerful motor by which it is driven. When the engine is started, the roar is deafening—so much so that in testing an airplanepower plant before it is mounted in a machine, the men who conduct the test must wear ear-protectors, similar to those used by the crews of our big coast defense guns.

But all this does not explain the cage in which the propeller is revolved during the test. What is the reason for that?

The cage is a safety device. It protects the men who are conducting the operation. Flywheels of steam engines sometimes burst when they spin too fast. Why? Because of the centrifugal force. The greater the speed, the greater is the centrifugal force. A propeller which revolves at the rate of fourteen hundred revolutions a minute might fly off, even though the utmost precautions are taken to fasten it securely to the shaft. And if it ever flew off—? A bursting flywheel has many a time wrecked an engine-house as effectively as a high-explosive shell, and a wild airplane propeller would be most unhealthy for anything it encountered upon its wanderings. The eye extends along the edge of the testing platform.

© Underwood and Underwood

Airplane propellers occasionally have their own ideas about flying. This cage discourages them

Kerosene Can Be "Cracked" to Produce Gasoline

IF crude oil yields different liquids when heated to different temperatures, what would happen if the separate distillates were treated again in the same way? The experiment has been carried out with astonishing results by different chemists—Doctor Burton, Doctor Hall, and Doctor Rittman. Kerosene, for example, can actually be made to give up gasoline. The process is called "cracking." Imagine before you two piles of stones of different sizes. The small stone-pile represents gasoline, the large one kerosene. A man with a hammer can obviously crack the larger stones into pieces equal in size to those of the first pile. The chemical equivalent of this seems to take place in cracking kerosene. Since kerosene is so difficult to dispose of, why not crack it and get enough gasoline for the four million automobiles which will be in use this year. Cracking processes actually furnished seven and one-half per cent. of the total gasoline production last year.

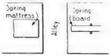
In 1918, at least one-fifth of the three billion gallons to be produced will be made by cracking. Their value would pay for ten superdreadnoughts.

Had it not been for the invention and utilization of cracking processes, gasoline would cost more than it does. During the year 1917, approximately 600,000,000 gallons of cracked gasoline were produced.

Seen from Above, This Picture Would Look Different

A SCENE like the above, wherein two Vitagraph comedians leap fifteen feet across an alley, cannot fail to give us a slight gasp. Well, how do they do it? Listen.

If you were up above the explanation would stare you in the face. For these laughable gentlemen would not be half so laughable if they were making the jump with nothing but their own two legs. As a matter of fact they are working under ideal conditions, precisely as if they were in a gymnasium. On one side is a springboard; on the other a spring mattress. It's a cheap thrill at only fifteen feet!



Those daredevil movie actors—with a mattress and springboard

We Are Presenting Germany with Two Hundred Aviators a Year

THE Germans claim to have brought down a thousand Allied airplanes during the past twelve months. It is estimated that with better physical training a fifth of these need not have been lost. As the training and equipment of these men would cost about $3,500,-000, according to Alan R. Hawley, President of the Aero Club of America, apart from the inestimable value of the men themselves, it would seem that we are paying rather dear for lack of attention to physical fitness. The men will never admit "staleness" though, for any reason.

Whale's Tail-Bones Made Into an Attractive Sign

THE Coronado Islands, off the coast of Lower California, not far from San Diego, have always attracted tourists because of the great numbers of whales, sea elephants, sea lions, and other large aquatic creatures, that disport themselves off the rocky shores. Taking advantage of these natural conditions, a boat company of San Diego attracts the attention of tourists to its docks by means of a sign painted on the great tail-bones of a defunct whale.

The broad flat bone forming the end of the tail makes the sign board, while the three other vertebrae form a convenient stand to support it.

It is doubtful if any sign more instantly commands the attention. The bones were brought in by one of the company's boats from the surrounding beaches.

This curious advertising sign is made from the tail-bones of a whale. Compare the glove

Two Boards Studded With Pins Make Bandage Folder

RED CROSS workers are greatly interested in a device for folding bandages, which has been invented by Edward J. Seeber, of Rochester, N. Y., and which is so simple that it may be made by anyone with the tools found in practically every household. The inventor has donated the free use of his invention to Red Cross workers everywhere.

The contrivance is intended for folding the eighty-one-inch bandages which form part of the emergency kit of every soldier sent to the trenches.

It is made as follows: An upright board, fourteen inches long, fastened to a horizontal base, has a series of ten three-inch pins, five on each side of a center bracket. The strip of bandage is placed over these pins, with the center of the strip over the bracket. Then the follower, a narrow board, about nineteen inches long, with twelve pins, arranged in such manner that they will dovetail with the pins of the upright backboard, is employed to press down the strip of bandage between the pins of the backboard, so as to pleat it, accordion fashion. Two hatpins temporarily fasten the folded bandage until the two halves are stitched and ready to be wrapped and sent out.

In these crowded days, when the compelling problem is to get the greatest possible amount of work done in the least possible time, and the dreadful nightmare of our own boys bleeding in far-off France urges us on, any device that increases the output is doubly welcome, and this, being of such simple construction, will recommend itself to everyone interested.


A home-made bandage-folder for Red Cross workers. It is simple and cheap


© Int. Film Serv.
No wonder the train was twelve hours late, or that the trainmen had suffered considerable hardship

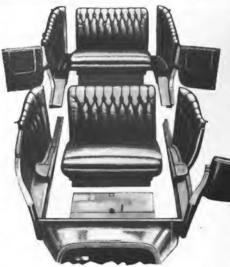
Like a Trip to the North Pole Is Railroading in a Blizzard

WHAT the terrific and widespread blizzards which raged through the middle western and eastern parts of the United States in the first week of January meant in handicapping the railroads and depriving large cities of coal and food is shown by the accompanying picture. Trains were snowed in and in some cases it took several days to dig them out. The trainmen suffered from cold and exposure to the driving snow and sleet, and frozen hands or feet were common. The accompanying picture is that of a locomotive of the "Soo" line, which arrived in Chicago after a fierce battle with snow and ice, which caused a delay of twelve hours in its arrival. One would imagine that it had been dug out of a drift.

Automobile Body That Packs Within Chassis Space

YOU have seen the advertisement pictures of knock-down bungalows and small cruising launches? The various parts are first put together, then marked, taken down, and finally packed one inside the other for shipment.

The same idea has been applied to reduce the cost of shipping automobile bodies by packing them in fifty per cent of their usual space. What is more a body can be converted into a two-seater, a four-seater or a delivery car with a small load-carrying box at the rear.



Sectional automobile body which can be assembled by the purchaser or dealer

In brief, the body consists of two side sills which are mounted directly on the car frame when assembled, and separate cab side portions, floor-boards, doors, rear, side, and end parts, the vertical and horizontal parts of seats, and even parts of the cowl and engine hood sides and top.

The various parts into which a body may be divided are shown in the accompanying sketch. When put together, the various parts are rigidly held in place by means of small bolts with countersunk heads, so that the entire body is a homogeneous unit which can be painted and varnished according to the individual taste of the purchaser. The convertible feature of the body is made possible by leaving off some parts and inserting others in their places to give two or four seats or a panel or box type delivery body as shown.

Use Fruit Trees Instead of Shade Trees or Even Ivy

A CONSERVATION of land space movement, in Germany, some time ago, resulted in the utilization of dwarf varieties of fruit trees instead of much of the shrubbery planted merely for ornamental purposes, and in the planting of small trees close against the walls of brick or stone houses so that the branches could be trained over the walls in the manner of ivy.

The accompanying photograph shows pear trees, pruned carefully and trained to spread out over the walls just like vines. The practice is now common in hard-pressed Germany and is likely to find favor in this country. Pear, plum, and other fruit trees are thus trained over housewalls, fences and garden partitions so that not an inch of ground is wasted. In this way, too, the trees are prevented from throwing too much shade over other growing things in their vicinity, and the appearance of the houses is, in addition, very considerably enhanced.

Pear trees trained to spread out over the walls of a house like ivy vines both for pleasure and for profit

A Floral Tank Struck a Warlike Note at the Pasadena Carnival

AT the annual Tournament of Roses in Pasadena, Cal., a marked change in the character of the floral decorations and floats was noticeable. Some of the floats in the parade introduced a warlike note. One of the most interesting was a facsimile of a British tank. It was thirty feet long, and fifteen feet high. The body of the tank was of smilax, the caterpillar treads were of gray acacia and the cleats were white desert holly.


Representation of a British Tank, made of flowers and smilax at the Pasadena Tournament of Roses

An Industrious Whittler Made This Endless Chain Out of a Board

THE chain shown in the picture constitutes a remarkable monument to the patience, industry and skill of Nicholas Burton, deceased, of DuBois, Pa. Burton conceived the idea of making an endless chain out of a single board. He selected a board twelve feet long, seventeen and a half inches wide and seven-eighths of an inch thick, and, with no other tool but his jack knife, carved this board into an endless chain of 4,522 links, with a total length of 305 feet. The links were each one and one-quarter inch long and seven-eighths of an inch wide. It took Mr. Burton just one year to complete this very remarkable and painstaking piece of work, each link of which is perfect.


A jack-knife and a man's skill and patience carved this endless chain from a board

Have Your Collar Stiffened Once for All and Eat the Starch You Save

THE separate starched collar was invented about ninety-two years ago by the wife of a blacksmith of Troy, N. Y., who made one for her husband. Since then it has grown in popularity until there is probably nobody who has not worn a starched collar at some time or other. Now its popularity is on the decline again, partly on the score of comfort, and partly as a result of the war.

The crux of the matter does not lie with the collar itself, though that is made from material which is useful for bandages. It's the starch that is to be saved—valuable foodstuff that ought not to be wasted on collars.

A permanently stiffened collar is being introduced which is not celluloid, but is a regular fabric collar treated with a kind of varnish that makes it possible to clean it under the tap or with a damp cloth. Automobilists should be among those who appreciate this new fabric, for, in spite of road dust, it is always possible to "feel clean" in a clean collar. A collar of this kind will last from two weeks to a month.

It's Raining, But the Glass Umbrella Keeps the Record Book Dry

THE numbers of the freight cars leaving or entering a depot, have to be recorded rain or shine. How to enter figures in a book during wet weather without blurring the pages has been a problem.

Now comes the "book umbrella," a small, oblong glass box, open at the underside to allow the number-taker to insert his hand. Of course, the book is held inside the protecting glass. Clips are provided at the top and bottom to keep the book open at the desired page.

The case is light, strong and durable. Clips hold the book open as required

The case, six inches square, is fitted with a strap which can be suspended from the clerk's shoulder. A larger sized "umbrella," made to hold loose, flat sheets, is also obtainable. For night use, an electric light can be affixed to the upper end of the box, and in addition to enabling the user to see to write, it answers the purpose of a lantern to see the necessary data written on the car and to get about the yard.

These Home-Made Tools Save the Cost and Keep of a Horse

WITH the home-made garden tools shown in the accompanying illustrations a man at San Jacinto, California, cultivates five acres of ground without the aid of a horse. On his grounds ornamental shrubs grow. A horse could not be driven close without injuring them. With a similar set of tools a small fruit orchard is also kept in condition.

The cultivator consists of a number of spikes driven into a three-foot piece of pine, and having their heads flattened to make a cutting edge. The top of the tool is reinforced with another piece of wood and a five-foot handle is fitted. A piece of iron gives the necessary weight.

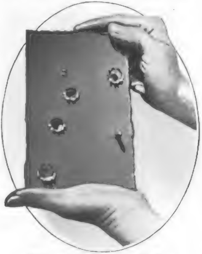
A rake similar to the one described, but with a strip of thin steel cut from a saw blade and soldered to the flattened heads of the spikes, is used as a weed cutter. The cutting blade is inserted from two to three inches below the surface of the ground and cuts off the weeds from their roots.

The above set of home-made cultivating tools enables one man to cultivate five acres of land without the necessity of keeping a horse, which would spoil his ornamental shrubs

Bullets That Shoot Through Steel

Medieval armor was revived, but it now bids fair to become once more obsolete

A BRITISH sniper lay behind his shield of quarter-inch hardened steel at the Ypres salient and smiled when a bullet from a vigilant German sniper crashed against the protection. He knew that nothing less than a couple of shells from some far-off field gun could bother him. When the next shot came, the smile faded from his lips. After dark he crawled painfully back to his trench-line, shot through the left shoulder. In the shield, which would turn a bullet at the very muzzle, there was a neat round hole, less than one-quarter of an inch in diameter and therefore smaller than the service bullet of the German rifle. From the shoulder the surgeons took the missile, a bullet made of solid steel, boat-shaped, with sharp point and tapered tail, and harder than glass. From other bullets of the sort, fired by the Germans for special occasions, the British were able to reconstruct the whole bullet.



Effect of Armor-Piercing Bullets

The revival of medieval armor as a protective measure has been one of the interesting sidelights in the present war. The first serious adoption was the steel shrapnel helmets, and since that time armor has been used more and more. Now, however, means have been discovered to pierce it and it would seem that it is about due to be once more relegated to the limbo of obsolete things. What will the next revival be?

Inside the German bullet, with its customary mild steel jacket—instead of the copper-nickel jacket used by the Americans and British for the same purpose—and inside a coating of lead, there lay a miniature bullet of steel, which the surgeons took from the sniper's shoulder and which had gone through the supposed bullet-proof shield.

Fired from the Mauser rifle of the German, the mild steel jacket and the lead covering of the steel bullet inside, yielded enough to take the rifling of the barrel, and the bullet flew through the air like any other bullet. When it struck steel, the leaden covering, and the thin steel jacket supported the steel point of the bullet within for a short instant, then they spattered into a spray of molten lead and fragments of jacket, and the steel bullet traveled on alone through the steel plate.

This is the principle of the armor-piercing bullet that is coming to be so common among the fighting armies of the world.

The corresponding American bullet is the Clay, invented by Captain W. L. Clay of our Ordnance Department. It is superior to any of the armor piercers made abroad. Through the construction of its point it will not glance off even the most inclined hardened steel surfaces, for armor surfaces are sloped when possible, to avoid a direct hit on the armor, and to make the bullet glance off harmlessly.

The Clay bullet has the jacket cut away for the last eighth of an inch at the point, exposing the soft lead. This in turn smashes down on striking, changing the shape of the point and making the bullet "bite" on the hard, inclined surface. Then the hard steel bullet within comes smashing through, while the lead and the jacket fly off in spray and fragments, their work done. The actual killing or wounding is done, of course, by the little steel bullet inside of the ordinary one.

Here is a group of English railroad employees worshipping the deity, Tea, under unusual circumstances

If You Work Hard, Eat More Pancakes

IT is a common mistake to suppose that to get the necessary strength to do hard manual labor, a heavy meat diet is necessary. This is far from correct. Muscular labor does not materially affect the demand for minerals and proteins, but rather for starches, fats and sugars. Therefore any additional wastage through muscular effort could be much better repaired by pancakes and sirup than by roast beef, for as much moisture and heat are wasted as tissue, so it is fuel that is required.

England Must Have Its Tea, Even If It Is Wartime

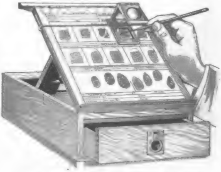
THERE are tea-parties and tea-parties. Some, like the Boston variety, have become historically famous; others have not. The tea-party in the picture, with its unconventional setting and sitting, is not exactly a "pink tea" patronized by the upper-ten-dom. It is really an interesting picture of wartime England. The women in the group are railroad employees in London. Chilled to the bone by the penetrating cold of an unusually severe winter day, these hard-working young women gathered in a secluded corner during a lull in their work, and warmed themselves and gained new energy by sipping piping hot tea.

Tea seems to be a *sine qua non* with our English cousins. War or no war, teatime is sacred. Apparently, judging by the war pictures, even the Tommies at the front religiously observe it—and at least it is stimulating.

How Finger Prints Are Studied With a Handy Portable Desk

FINGER prints of criminals are photographed and filed away for reference. A filing cabinet which makes it easy to handle the photographs has a board hinged to the top which can be set at any desired angle. A place is provided for a magnifying glass through which the finger prints may be studied. A mounting board which is ruled into spaces for right and left hand prints makes the examination of the photographs very simple.

When not in use, the board drops down into the top of the case. Under the board is a drawer which provides the necessary space for filing the photographs.



This filing cabinet for finger prints saves much time and trouble for investigators

This filing system makes it convenient to classify the thousands of prints by various groups and sections, so that any particular set or sets can be obtained immediately for study or comparison with others. The whole thing is compact and convenient.

FOR PRACTICAL WORKERS

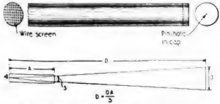
A Chemical Preparation to Preserve Cut Flowers

IF a little saltpeter, or carbonate of soda, is added to the water in which flowers are left standing, they can be kept comparatively fresh for more than two weeks. Another method is to add a small amount of ammonium chloride, or camphor, to the water. The presence of one of these substances stimulates the plant cells and acts in opposition to germ growth. Flowers that have wilted can be revived for a time if the stems are inserted in a solution of weak camphor water.—HERMAN NEUHAUS.

Simple Construction of a Useful Range Finder

ONE of the simplest range finders ever devised consists of a short tube, one end closed by a cap pierced with a pin-hole, the other end covered with a wire screen of square meshes.

The manipulation is as simple as the construction of the instrument. With the eye close to the pin-hole, look through the tube at some distant object of known



The tube with its peep hole and screen covered end and formula to compute distances

length (say a distant freight car). The wire mesh will stand out clearly in the field of view, and the number of spaces which are outlined against the object may be readily counted off. (In the accompanying illustration the tower is six spaces high.) It is evident that the object is farther from the peep-hole than the wire mesh, in the same ratio as the length of the object is to the aggregate width of screen openings which enclose it. (See preceding diagram). Suppose a 50-ft.

In looking through the range finder the object is covered with the mesh screen

freight car is covered by four spaces of a 20-wire-to-the-inch screen. The distance to the car is obtained by multiplying the length of the range finder by the ratio of 50 ft. to 4/20 of an inch, i. e., by the ratio of 3000 to 1. If the range finder is 2 ft. in length, the car is two thousand yards distant.

It is plain that this type of range finder is restricted to use with objects of a known dimension. The height of a distant man may be taken as 70-in., with a probable resulting error of less than 5 per cent. Objects of a fairly standard length should be chosen. Recording to fifths of a screen space is comparatively easy. Even a novice may determine ranges with an error not exceeding 10 per cent.

A Self-Contained Hot Water Foot Warmer

IT has been shown that a certain combination of salts brings about the generation of heat. By applying this

Pouring the salts into water to make a mixture that produces and holds heat

chemical phenomenon, a cheap and efficient warming bottle may be formed. First of all mix together sodium acetate and sodium hyposulphate in water, using one part of the former to nine parts of the latter salt. There should be a sufficient quantity of these materials to fill the earthenware bottle three parts full. The vessel should now be loosely stoppered and placed either in hot water or in an oven until the salts have completely dissolved. For many hours after this the bottle will radiate considerable heat. To renew the warmth-giving properties, it is only necessary to give the bottle a good shaking.—S. LEONARD BASTIN.

Circulating Air in a Room to Warm It Evenly

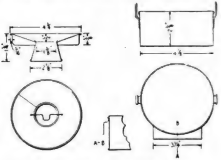
THE temperature of a heated room is several degrees warmer at the ceiling than at the floor. To equalize the temperature, it is necessary for the air to be in circulation. This may be accomplished with an electric fan, but to prevent any unnecessary draughts, the blast from a fan should be confined. As the air must be driven from the floor to the ceiling, place the fan in one corner of the room in such a position that it will drive the air upwards. To keep the air confined, make a cardboard tube about 6 in. in diameter to carry the air up and across the ceiling to the opposite corner of the room. This will take the cold air from the floor and force it out at the ceiling level. Naturally the air currents are forced from a lower to a higher level, thus equalizing the temperature.—JOHN T. FORD.

Inward Flaring Cover for an Oil and Plumbago Can

THE photograph and drawings illustrate a very handy "dope" can which is convenient in many ways to the mechanic. The mixture, more commonly known as "dope," being a combination of plumbago and oils, is used on thread joints to prevent them from rusting and being difficult to remove.

You can't spill everything from this can

Due to the construction of the cap or cover, the can, if overturned or upset, will always retain a goodly portion of its contents. Around the opening or mouth a piece of wire is bent and soldered in the form of a loop. This affords a good swipe for the brush, cleaning off any surplus which may adhere to the bristles. It keeps the mouth of the can clean as the oil surplus drops at once into the middle of the opening. The square shouldered



Details of the parts for making the can with its flaring cover to hold the lubricant

portion on one side will be found very convenient for catching and holding the can on any projection which may be near the work requiring the application of the dope.—F. W. BENTLEY, JR.

Portable Brush Burner Carried on a Truck

THE accompanying illustration shows a labor-saving device which is used by fruit growers in a western valley. It is a portable brush burner used mostly in young orchards where there is less danger of damaging the overhanging branches. In older orchards, where the trees occupy a larger space, it is customary to gather and haul the brush out of the orchard, to be burned. But this simple brush burner is a labor-saver in the young orchard where little pruning is needed. An ordinary brush pile burned on the ground spoils vegetation and the ashes resulting from the fire have little value if left in a heap. The burner keeps the heat from the ground and the ashes may be strewn where needed.


The sheet metal is curved to hold the brush and is supported on the wagon truck with metal pieces

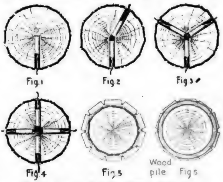
It consists of a steel plate bent in a U-shape and supported on a truck with curved angle iron held above the woodwork by metal braces. It saves handling the brush several times, as the men can throw the brush on to the fire and save two haulings.

It costs about $2.50 an acre to handle brush with this device, and where a large acreage is to be cleared, this is less than it costs to use a team and men hauling it out of the orchard.—EARLE W. GAGE.

It's Easy to Blast Trees or Timbers with Dynamite

IT is a very simple matter to blast almost any kind of timber work with the aid of dynamite, without danger, if certain simple rules are followed. To blast trees or timbers a charge of ½ lb. per square foot of sectional area is placed in holes in the same cross-section, which will be sufficient to cut off trees and round or square timbers of ordinary proportions. The holes back of the cartridges are filled with clay and tamped. One stick placed as shown in Fig. 1 will usually be sufficient to bring down a tree of less than 13 in. in diameter, while two sticks placed as shown in Fig. 2 will be enough for a tree under 19 in. in diameter. Three sticks placed as in Fig. 3 will be required for a tree or timber under 23 in., and four sticks placed as in Fig. 4 will bring down a tree 27 in. in diameter, or less. The charges should be fired simultaneously, but if firing must be done by time fuse it is often advisable to place one charge and explode it; then place the second charge, and explode it; and so on.

If a timber is not over 12 in. in diameter and no boring tools are at hand it may be readily cut down by encircling it



Various methods using different numbers of sticks of dynamite for felling trees

with a chain of cartridges placed on the same plane as in Fig. 5. The ring must fit snugly against the wood and should be fired with primers on both sides. This method is also effective for piles and trestles under water. The cartridges may be secured to a ring or hoop as shown in Fig. 6 and slipped down into place.—GEORGE M. PETERSEN.

Cement Flower Boxes Made in Mud Molds

MOST of the really artistic and beautiful flower vases and boxes of pottery and stone for use on verandas and lawns are very expensive. But the boxes illustrated may be easily made from a mixture of cement, sand, and coarse gravel. This mixture may be molded into original and artistic flower-boxes and vases by means of plain mud mixed from clay soil.


Two boxes made from cement which is formed in handmade molds of plastic clay or mud, making irregular shapes of the surfaces

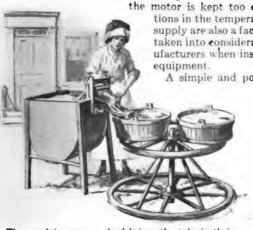
The beauty of the finished products rivals that of the most expensive flower vases and boxes of stone and pottery, and their cost is almost nothing. They can be made in any color or in blends of several colors by adding coloring pigments to the cement in the mixing.

To make them, follow these directions: Make a cement mixture of 1 part good cement; 2 parts washed sand, and 1 part washed coarse gravel. To this dry mixture add just enough water to make it run freely into crevices. Procure some clay soil that will mix up into a sticky mud and mix up a tubful of this to the consistency of putty. With bare hands take chunks of the sticky mud and slap it down on the ground in the shape you have decided to have the vase or box.

Remember that the inside of the mold you are forming should be kept rough and irregular. If you have your mud mixed to the right consistency you will have no trouble in taking it from the pile in large sticky lumps which you are adding to the base of the vase or box and piling it up, leaving the inside shape in the form of the receptacle you are making. Build up the mold about 18 in. high and then fill in with the cement mixture. It will run into the crevices everywhere around the mud form. When level full begin building up your mold of mud again. When you are ready to form the bowl, begin to build up a mud form in the center and leave about a 2-in. space all around the side walls of the mold. After it is shaped and built up high enough to suit your fancy, fill in with more cement mixture until it is level full. You now have the walls of the receptacle formed. Top them off with more mud, pressing the chunks down into the cement to give the edges of the walls thus formed an irregular shape in keeping with the rest of the receptacle. Let the whole mass stand undisturbed for one week, after which time the mud will begin to crack and break away. You can then chip it away carefully from the cement, revealing the shape of your flower vase or box. Dig the mud out of the bowl and let the cement weather for two days more. Now you can wash the mud out of the crevices in the cement, and you will be surprised at the artistic cave-rock formation you have obtained. After a little practice you will be able to create any formations you desire by shaping the sticky lumps of mud in that way. No two receptacles will ever be exactly alike. Once the cement is thoroughly dry it is as hard as solid rock. The boxes are as substantial as if made from solid stone and are practically indestructible.—J. R. SCHMIDT.

A Revolving Washtub Stand Made of Cart Wheels

As the lady of the house asked for a washtub stand, the scrap pile was given a thorough search to find boards enough to make one. While doing this two discarded cart wheels were discovered and immediately these suggested the idea of building a rotating stand. The axle was procured and cut down so that its length was right to make the stand hold the tubs beneath the wringer on the machine. One wheel formed the base, to which braces were attached to hold the axle upright. The other wheel made the revolving top. Two or three tubs can be set on such a stand and be brought beneath the wringer in turn.—Henry Klaus.


The revolving upper wheel brings the tubs in their turn under the wringer upon the washing machine

Proper Cooling for Engines of Motor Boats

A considerable improvement can be made by motor-boat owners in the proper cooling of the engines as installed by the makers, that will result in increased enjoyment and comfort in the use of their craft.

As the water for cooling the motor is taken from outside the hull there is always a plentiful and cool supply to draw from, and the boat owner never has to worry about a leaky radiator or an overheated engine as does the autoist. But herein lies one trouble with many marine motors—they are often cooled too much. To obtain the greatest efficiency from the fuel consumed, a gasoline motor should run fairly hot. The fuel vaporizes more perfectly, the compression is better and therefore a motor develops more power when hot than when it is cold. Of course this may be overdone. There are certain limits that should be observed in both directions.

On many motor-boats the pipes for conveying the water to and from the engine, and also the water pumps, are much larger than needed and as a result the motor is kept too cool. The variations in the temperature of the water supply are also a factor that is seldom taken into consideration by the manufacturers when installing the motor equipment.

A simple and positive method of regulating engine temperature is to place an ordinary globe valve at some accessible point in the pipe line leading to the engine. By using this valve the heat of the motor can be controlled to compensate for the differences in the temperature of the water supply to secure the best working condition.

The proper cooling of the exhaust pipe line is another detail that is often not given proper attention by boat makers. When the exhaust pipe runs directly from the motor out through the side of the boat no cooling is necessary, but when it runs under the seats along the side and out at the stern the heat is unpleasant and may sometimes be dangerous.

To correct this trouble it is only necessary to tap the cooling water discharge pipe at some convenient point and connect a 1/8-in. pipe to the exhaust line. A globe valve should be placed in the pipe line to regulate the flow of water into the exhaust line. The connection into the exhaust should not be made too close to the motor; 8 or 10 in. from the cylinder is about right.

By adjusting the valve in the pipe line enough water can be admitted into the exhaust pipe to keep it cool.—N. C. Helms.

Dissecting a Rubber Plant to Make It Grow

TO transplant rubber plants successfully requires careful work on the part of the inexperienced horticulturist. The rubber leaf should be cut off with a part of the plant attached to the leaf stem, as the accompanying illustrations show. The branch is so important that without it the leaf will soon wither and die. The next operation is to fold up the leaf carefully and to wrap it securely with a piece of string. The plant can now be planted in wet sand in a hot-house or placed under a bell jar in the home. The leaf is folded and tied so that the sun will not absorb the moisture from its delicate structure. This moisture, in turn, feeds the stem and branch of the plant until they are able to draw their own moisture from the soil.

Carefully handling the rubber plant for transplanting. The folding prevents evaporation

---

Cold Rolled Steel and Cold Drawn Steel

ALMOST every person in the mechanical trades is familiar with steel that is smooth and has a bright finish. This steel comes in bars, rolls and shafts, and most of us call it "cold rolled steel" or "cold drawn steel." As a matter of fact there is a wide difference between the two, in the process of making, in the nature of the steel, and in its use. To be strictly correct and to avoid mistakes, which may be costly, these differences should be carefully noted.

Cold *rolled* steel is, as its nature implies, rolled cold under great pressure, the material used for the purpose being hot rolled (black) stock. The machine which does this work is called a rolling mill, and consists of a pair of heavy, hard, and highly polished steel rolls mounted in a massive frame and suitably driven. The sheet or strip is passed between the rolls, which impart the smooth finish and exact size and shape, whether rectangular, square, round or otherwise. Due to the great pressure, the action of the rolling is also one of squeezing, and the stock comes out thinner, wider and longer than when it went into the rolls, and with a rounded edge, which retains the black finish of the original.

Cold rolled steel may be obtained in "flats" and in strips in a great variety of sizes and in thicknesses of from .002 in. up. It is relatively soft and is used mostly for bending and stamping purposes where a steel of accurate thickness, bright finish, and easy working qualities is desired. The thinner and narrower stock may be obtained in coils or rolls for use on automatic machines that work from a continuous piece. Cold rolled steel is used extensively for drawing operations; that is, for the making of caps, cups, covers and shells.

Cold *drawn* steel is finished by an entirely different process. It is this process that gives us shafting, bars, rods and keys, smooth, bright, strong and very accurate. To obtain these desirable qualities a bar of hot rolled steel, slightly larger than the finished size, is run through a machine known as a draw bench, which has a highly polished, heavy and hardened steel die with an opening the exact size of the finished bar. By means of a powerful chain and gripping apparatus, the bar is pulled or drawn through the die.

Buckboard Driven by Motor Wheel

Detailed description of how to make a buckboard to be propelled by a push-motor wheel

By Frank W. Vroom

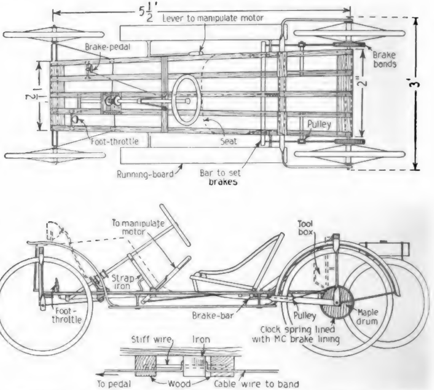
NATURALLY, the first part of the work upon this buckboard is the frame. The material to use is perfectly dry, straight-grained ash. If this wood is not obtainable, well-seasoned hickory ⅝ in. thick may be used. It will require five pieces of ash, each 5½ ft. long, 2 in. wide and ⅞ in. thick. These are joined together at the ends with cross pieces, the front cross cross piece should be 18 in. long and the rear one 24 in. long; both should be 3 in. wide and ⅞ in. thick. These are fastened to the underside of the long pieces with wood screws, or, better still, with some small bolts. Another cross piece 21⅜ in. long and 2 in. wide is placed across the frame pieces at the point where its length corresponds to the width. This piece is to hold the ends of the strap iron braces which support the outer ends of the rear axles.

The finished buckboard presents a very neat appearance and will carry its load as fast as a motor wheel runs

The axles are made of 1-in. square bar machine steel, each 3 ft. long with the ends turned down to ⅜ in. in diameter for a length of 5½ in. These are threaded to take a bicycle wheel cone snugly. Holes are drilled 6 in. in from the shoulder for a small bolt to fasten the frame to the axle. The rear axle is placed directly beneath the cross piece and the front one is fastened to a piece of oak 2 ft. long and in. wide. Bore a hole in the center this oak piece to receive a bolt ⅝ in. in meter. This bolt is 4½ in. long. As ar bicycle wheels are used, the axle are threaded to receive the cones nd rear and nuts on the ends to hold the adjustment. The front wheels are 24 in. and the rear ones 28 in. in diameter. Non-skid tires should be put on the rear wheels.

The easiest way to equip the machine with mudguards is to utilize the regular stock guards used for bicycles. Second-hand guards can be purchased at a reasonable price and they will do as well as new stock.

The steering post consists of a piece of gas pipe 2½ ft. long and ¾ in. in diameter. A block of oak, or other hardwood, long enough to reach between the center slat and the next one to its left, has a slanting hole bored in it which brings the other end of the pipe at a position most convenient for the operator to handle the wheel. The angle is about 45 deg. The best way to find this angle is to incline the pipe with one end touching the block under the slats and to tip the other end until the distance, at the right angle, between it and the frame measures 19 in. This brings the steering end at a convenient position for the average person. The block should be well up in front. Another block should be set on top of the slats at a point where the pipe will intersect it. The pipe must be allowed to turn freely in a hole bored into its center. This block should be halved, or sawed through the center lengthwise and held together with an adjustment screw in each end. For additional support, a piece of strap-iron should be bent over a pipe the size of the post and the parts riveted together like a clamp.

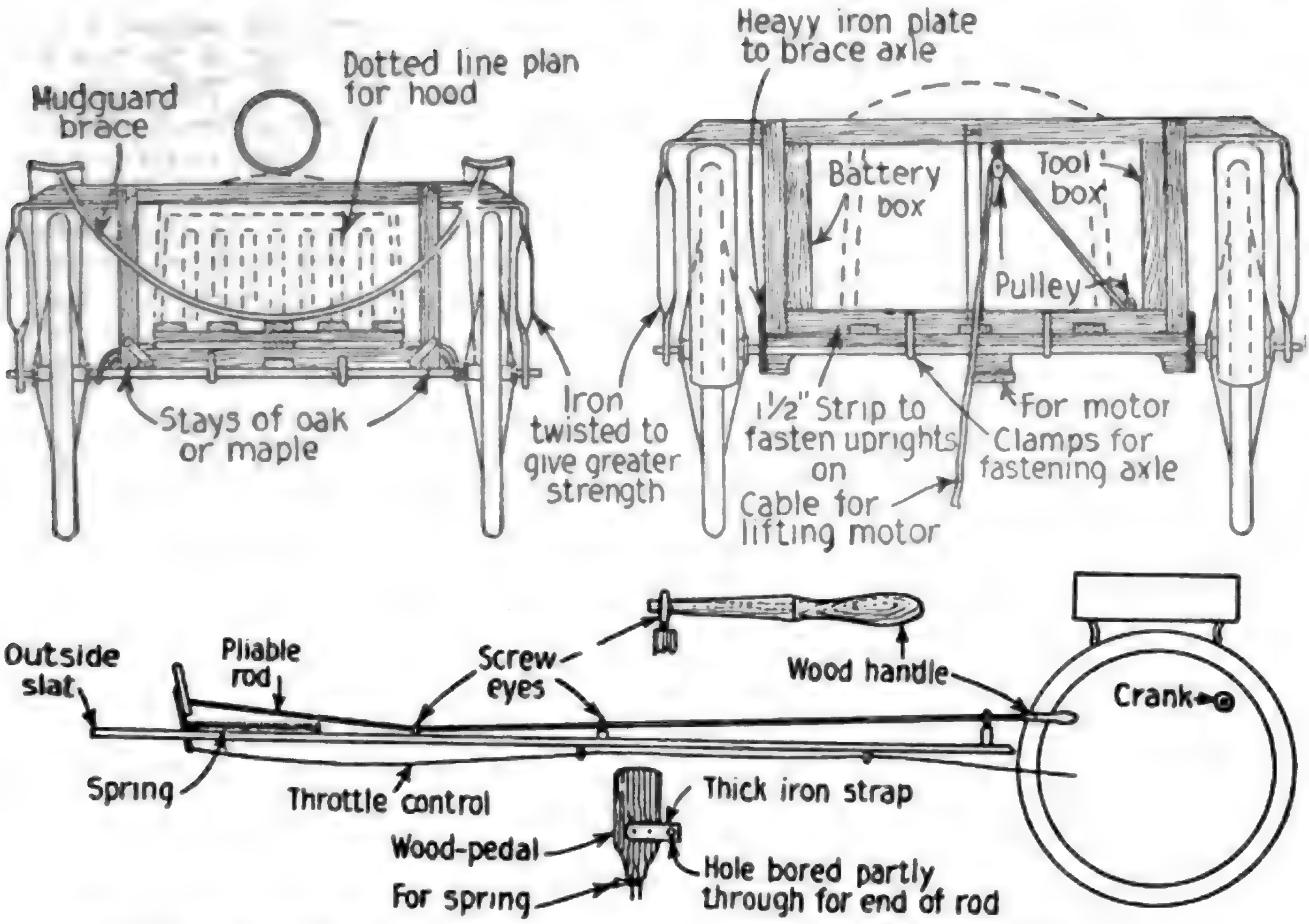


The connecting link between the front and rear axle is made up of five pieces of ash which furnishes the spring to ease the rider. Driving attachments are fastened to these pieces

Then fasten the ends to a cross-piece on the slats, spreading them out at the bottom like the shape of an inverted V. The steering wheel can be made, if desired, or it can be purchased. A wheel may be obtained such as is used in the place of handlebars on a bicycle. This is fastened to the end of the post.

The steering is accomplished by an arrangement of five pulleys of the drum-cable variety. Four 2-in. pulleys are placed under the frame; two on a ⅜-in. rod placed directly under the steering post, and at the same angle as the post over which the cable passes. The other two are placed, one on each side of the frame, outside of the slats. One of them should line with the pulley next to the post block and the other with its mate. The drum—large pulley—should be 3 in. long and 3 in. in diameter, and it should be placed close to the top of the block on top of the frame. It is fastened to the steering post with a long wood screw, which goes through a hole bored through the center of the pulley, and a similar hole drilled through the post. The hole in the post should be a sliding fit for the screw and the hole in the pulley should be a tight fit. Fasten a 6-ft. length of wire to one side of the front axle. Pass it around the pulley under the frame to a pulley on the shaft under the post and then to the drum on the post. Wind four turns around the drum, and run the end down under the other pulley on the shaft. Then pass it around the outside pulley and fasten to the other end of the axle.

The lamp was made from a large oil can. The spout was removed and the hole reamed out to receive the screw end of a 12-candle-power electric globe. The

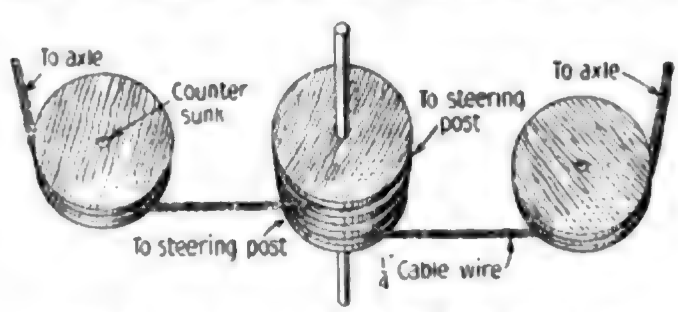


The upper picture shows the front and rear part including the axles and wheels and the lower one the arrangement of the foot pedal and rear control of the throttle with a wire and rod

bottom of the can was removed, care being taken to leave a clean edge. A round piece of glass was cut out and its edge covered with a strip of sheet galvanized metal which was cut as shown. This covering was hinged to the side of the oil can and a snap fastener was attached.

The brake drums were made of hard-wood, cut and turned to a diameter of 6 in. The centers were bored out to fit over the check nut on the wheel hub. The drums were fastened to the sprocket by drilling four holes through the latter into which were inserted screws or small bolts. A strip of metal was fastened to the outside surface for the brake strap to rub against. Measure three-quarters of the distance around the disk and cut a heavy clock spring to this length. Draw the temper in each end and drill two small holes in one end and rivet it to a piece of ½-in. square bar 3 in. long. Drill a single hole in the other end and fasten a cable wire for operating the brake. Bend the spring to the curve of the disk and rivet a strip of motorcycle brake lining to inside surface. If this material cannot be procured, a heavy piece of leather will do, but it will not wear so long. Fasten the free end of the bar to the under side of the outside slat at a point where it will just clear the disk. Fasten a piece of 3/16-in. cable wire to the single hole and run it down and under a wood pulley placed midway between the disk and brake bar, as shown, thence to the end of the brake bar where it is fastened in a notch.

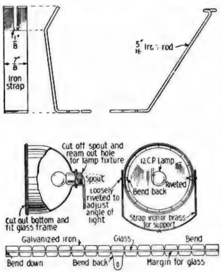
The brake bar is made of a piece of ½-in. square bar steel, placed across the



The arrangement of the pulleys, wire and drum for the steering of the front wheels

slats toward the front as shown. It is fastened by boring a small hole through the center and at each end. A small,

stiff wire should be run through a small block previously bored for a close fit in the hole in the end of the bar and through a hole in a similar block placed 3 in. from the first block. The opposite side is made in the same manner. Fasten a



The braces for the frame and the construction of a lamp by using an oil can

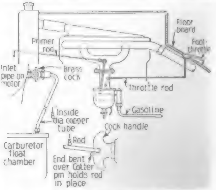
short length of stiff spiral spring to the center hole in the bar and fasten the other end to a cross bar of wood as shown. Run a length of cable wire from the center of the bar to the foot pedal in front. Run this cable straight on the center slat for half the distance to the pedal and then turn it off to the pedal and fasten it.

All braces are made of $\frac{1}{8}$ by $\frac{7}{8}$-in. strap iron. The braces, from the frame to the axle, are twisted in the center to make them more rigid. After placing the uprights, these braces can be easily measured and fitted in place. The end stays should be bent at right angles at the proper height and then they should run to the upright as shown. The side braces from the frame to the axle are run all the way across the frame, joining in the center of the wood cross piece. Turn three or more screws in each piece, securely fastening them in place, as these uprights form the main support for the axle ends. The seat was made of an old chair cut down to a convenient size.

The motor wheel is provided with fastenings for attaching it to the rear cross-piece of the frame. Provision may be made for lifting the wheel from the ground by means of a foot pedal for stopping and starting the buckboard while the motor is still running. This provides a way to start the engine without running the machine along the road.

Priming an Automobile Engine to Start It Easily

IN winter weather a primer for the automobile motor is very essential and the idea here illustrated combines practicability with simplicity at small cost and is convenient as the hood over the engine does not need to be raised. It is made as follows: Drill a $\frac{1}{4}$-in. hole in the intake manifold pipe and fit a brass cock in it, care being taken in drilling and tapping the threads so that the aluminum is not ruptured. Drill a 3/16-in. hole in the top of the carburetor float chamber and connect it as shown. The bottom end of the primer tube must be so placed in the carburetor float chamber that it does not interfere with the float, but the end of it must enter under the gasoline level. To prime the motor, simply open the valve on the intake manifold and the motor will draw in raw gas, automatically priming itself and greatly facilitating the starting

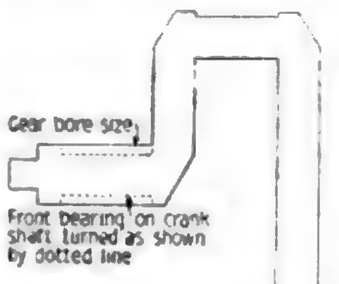


Hand controlled connection for admitting a rich mixture to manifold from carburetor

of the motor in cold weather. If the motor is a self starter, run the primer rod to the dashboard and reverse the position of the cock.—P. P. AVERY.

Affixing a New Bearing Surface to an Engine Crankshaft

WHEN a bearing becomes slightly worn it not only wears faster, but it may do a great deal of damage to the other wearing parts of the machine in which it is located. There is no part of an automobile that can cause damage quicker than the crankshaft of the engine, and one loose bearing will soon cause wear on all the working parts. If the engine produces a "knock," remove the radiator and run the engine a few minutes. This will usually give evidence of the worn part. Most engines have the front bearing solid, at least it was so in the engine to which this description relates. In this case the crankshaft was considerably worn and it was necessary to cut it down somewhat to obtain a new straight bearing. This was done as shown in the illustration. The space was filled in with a two-piece bearing, scraped to fit the shaft. It was drilled for oil holes and grooves were cut in it like the other bearings. To assemble it, set the crankshaft in the case and apply the two parts, then force it into the front bearing. Drill holes through the bearing and parts, and tap for setscrews to hold them in place. This will make such a bearing as good as new.—P. P. AVERY.



Worn part filled in to make bearing

Small Wood-Working Clamps Made of Skate Parts

THERE are lots of little jobs in the shop where clamps are needed—gluing up small pieces of wood, for instance—and the ordinary clamps are too large. For such work, the clamps from old roller or ice skates can be used. Take the two clamps and the screw and use the skate key to tighten them on the work. Put a small piece of wood under each to prevent the work being bruised or dented. This is a cheap and accessible expedient as old skates are to be found in most households.—KINGSLEY GREENE.

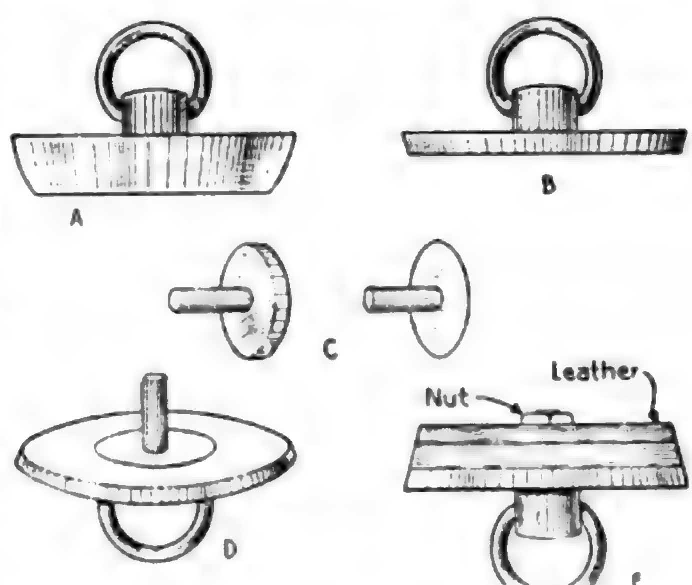
Shaping a Bottle Cork to Make a Medicine Dropper

Notches as they are cut in the cork

A VERY convenient form of medicine dropper may be made by any one upon a moment's notice by simply cutting two small notches in the sides of a cork, as shown in the illustration. When inserted in the neck of a bottle the liquid may be poured out in a regular intermittent flow of drops as slowly or as rapidly as desired. The neck of the bottle should be held just a little above the horizontal to prevent a too rapid flow, particularly in the case of poisons.—FLOYD L. DARROW

How to Repair a Worn Wash Bowl Plug

A BRASS bowl plug had been in constant use for a long time and the wear rounded the edges on the underside as shown at *A*, the edge being a mere shell from the wear. The worn part was filed down as shown at *B*, next a screw

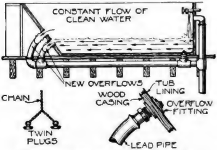


Making a new contact surface of leather on the face of a worn wash bowl plug

terminal, *C*, taken from the end of a battery-carbon was soldered on as shown at *D*. With this attachment, two leather disks were secured to the surface with a nut. Then the edges of the leather were trimmed down to the original form of the plug as shown at *E*.—JAMES M. KANE.

Systematic Control of Water in a Bath Tub

A RESIDENT of a small city, wishing to eliminate the final sponging with clear water, necessary to remove the previously applied coating of soapy liquid, decided upon this method of keeping the water constantly clean. As the tendency of the water was to carry the soapy matter to the end farthest away from the bath overflow, two overflows and plugs were fitted at the opposite end, thereby providing for two water levels. Regulating the flow of water from the bibbs, the bather was able to keep the unclean water constantly moving out of either of the two overflows.—JAMES M. KANE.



Two overflows at different levels in the bath-tub, opposite to the faucet

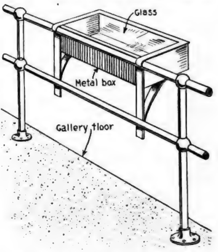
A Cement for Firmly Holding Glass on Metal

ONE of the best cements for joining glass to other substances consists of a mixture of gum arabic and calomel. Its ad[illegible] is great. It is prepared [illegible]ery best and purest gum [illegible]all quantity of water, [illegible] to stand overnight so [illegible] a glue-like consistency. [illegible] it is sometimes called, [illegible]loride or subchloride of [illegible]ed in a sufficient quantity [illegible] a trifle more sticky. [illegible]re thoroughly mixed on a [illegible] spatula. Calomel is a [illegible] should be made than is [illegible]e use. This cement hardens in a few hours, but the most satisfactory results are obtained when it is permitted to stand for one or two days. To insure a very serviceable cement it is necessary to utilize only the best materials, as inferior grades are useless. Another excellent glass cement is made from gum mastic, powdered isinglass and alcohol.

Fastening Cases to Railing in Historical Museum

THE method used in placing the manuscript cases in the Historical Society building in a small city is shown in the illustration. It is a good example of economy in space. The gallery running around the upper section of the library room has a pipe railing to keep the clerk from falling off to the lower floor.

The upper rail has been utilized to hang cases containing valuable manuscripts. The framework of the case is of flat iron, the back ends of the top being curved so as to hook over the upper pipe rail.



A glass case holding manuscript for exhibition on the guard rail of a gallery

By using this method the manuscripts are perfectly safe, they are in a good light, and it is possible to examine each one by itself.—JAMES M. KANE.

Simple Designs for Sheet Metal Working

XI.—Radial Line Method of Developing Patterns for a Ventilator and a Scale Scoop

By Arthur F. Payne

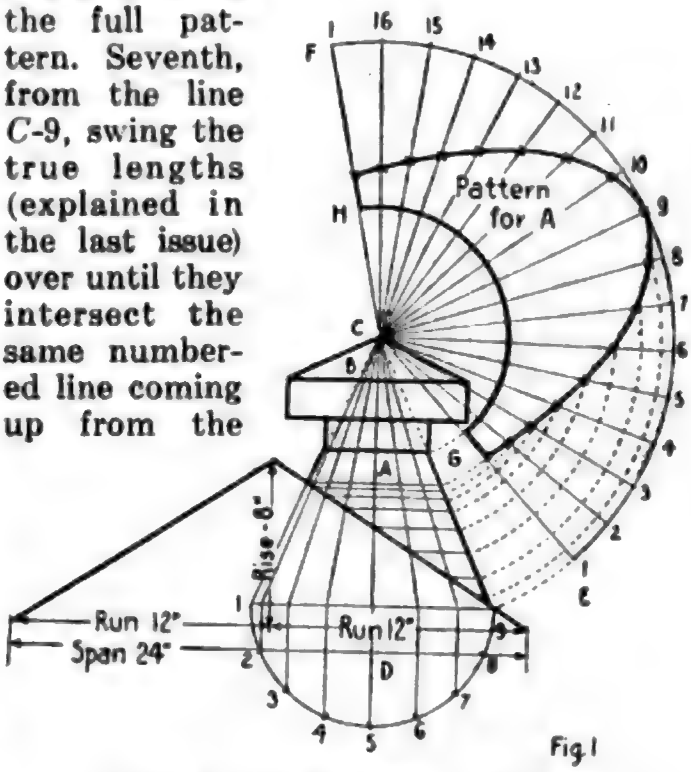
Former Director of Vocational Education, Columbia University

FOR those who have developed the problems explained in the last issue, Fig. 1, "pattern for ventilator on roof with one-third pitch" will merely be an easy review of the principles involved.

Before starting on the pattern development it is necessary to explain the meaning of the term "one-third pitch" as applied to a roof. When an order comes into the shop for a ventilator of any given size which is to be placed on the side of a roof, it is necessary to know the pitch and angle of the roof. The contractors always state that it is a one-third, one-fourth or one-sixth pitch. Before this can be explained it is also necessary to become acquainted with the terms "span," "run," "rise," and "pitch."

As shown in Fig. 1, the "span" is the entire width of the roof; in this case it is 24 in. The "rise" is the length of a line dropped straight down from the ridge until it is level with the edges of the roof, in this case the measurement is 8 in. The "pitch" is the relation between the span and the rise. In the illustration the rise is 8 in., the span is 24 in., 8 in. is one-third of 24 in., therefore the pitch of this roof is one-third. If the rise had been 6 in. and the span 24 in., the pitch would be one-fourth because the relation of 6 in. to 24 in. is 4 ins. Conversely, if the rise had been 4 in. the pitch would be one-sixth because 4 in. is one-sixth of 24. It is essential to know the pitch of the roof before we can develop the ventilator pattern.

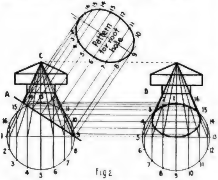
The pattern for *A* only has been developed because *B* is a simple cone, the development of which was given in the March issue. As the ventilator is a round one, it can readily be seen that *A* is part of a cone. First, it is necessary to draw the full view of the ventilator as shown. Second, draw the full cone as indicated, with *C* for the apex and 1-9 for the base line. Third, draw the one-half bottom view as shown by *D*, and divide this into eight equal spaces. Fourth, run these points straight up to the base line, then to the apex *C*. Fifth, where these lines cross the roof line run them over to the line *C*-9. Sixth, with the length C-9, as radius strike the arc *E-F*, and get the correct length by stepping off one of the spaces on the bottom view sixteen times. It must be understood that the bottom view has only eight spaces because it is only one-half of the bottom view, but there must be sixteen spaces in the pattern because it is the full pattern. Seventh, from the line *C*-9, swing the true lengths (explained in the last issue) over until they intersect the same numbered line coming up from the arc *E-F*. At the intersection make a cross, connect these crosses with a free curve and we have the bottom line of the pattern. Eighth, to get the top line of the pattern set the compasses at *C* and *G*, then swing the arc *G-H*, which gives the top line, thus completing the full pattern for *A*. The patterns for the straight collars can be quickly developed by methods explained in earlier articles.



A pattern layout for making a base to a ventilator to be placed on a sloping roof

No attempt has been made in the drawing to show the full construction of this

ventilator, or to give sizes, as it would complicate the drawing and confuse the student. Allowance must be made on the patterns for all seams and wiring.



Laying out a pattern for cutting a hole in the roof for insertion of the ventilator base

A very interesting and simple problem that is not generally known among sheet metal workers is shown in Fig. 2. If, when making the ventilator shown in Fig. 1, it is desired to obtain the pattern for the hole in the roof, the method is as follows: First, draw view *A* with the full bottom view as shown by the circle. Second, divide the circle into sixteen parts, and project the points to the base line. From where they cross the base line, run the lines up to the apex *C* exactly where on these lines, draw the center line 1-9 parallel to the roof line. Notice that now we have the exact length of the hole and the exact location of each radial line. If we can now get the exact width on each of these lines, we shall have our pattern. We can get these widths by drawing a front view. Make the drawing the same as for the side view except that the roof line is omitted. Notice particularly that the numbers on the bottom view circle have been turned one-quarter circle to the right, although on the ventilator they are, of course, in the same place. For instance, 1 is the highest point and 9 is the lowest point on both views. Fourth from view *A*, where the radial lines cross the roof line, run lines to the front view *B*. Make a cross where these lines intersect, the same numbered lines coming up from the bottom view circle. Connect these crosses with a curve and you will have a true front view of the joint between the ventilator and the roof. It is understood that the upper part of the oval would be back of the ventilator and therefore invisible from the front. Sixth, to transfer these widths to the pattern, place one point of the compasses on center line, and find the width of 2-16, then lay this off on the 2-16 line of the pattern. Transfer all the other widths in the same way, connect the crosses with a curve and you will have

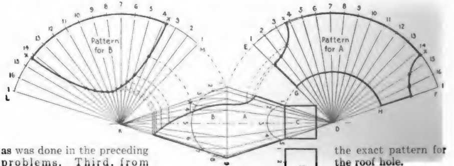


Fig. 3: Pattern layout for making the three parts of the ordinary scale scoop. Two of the pieces are parts of a cone while the other is a plain cylinder

as was done in the preceding problems. Third, from the points where these radial lines intersect the roof line, draw lines at exact right angles, as shown in the drawing. Number these lines, giving them the numbers at the bottom view points from which they started. Any- the exact pattern for the roof hole.

In Fig. 3 the "scale scoop," we have an interesting and apparently difficult problem, but one which is much easier than it looks. This scoop is circular in

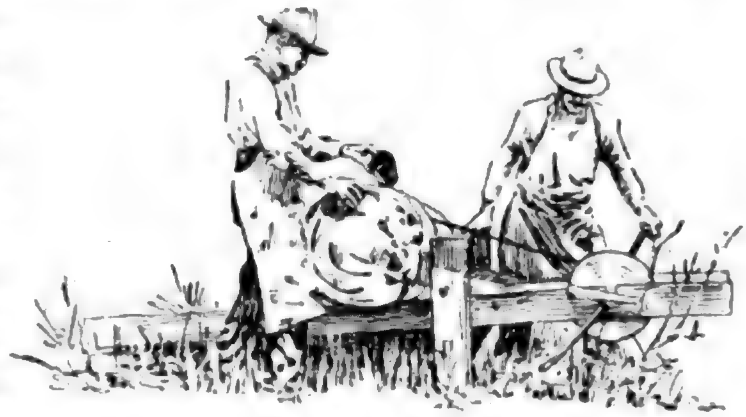
form and by examining the drawing it can be seen that *A* and *B* are part of cones of the same size. *C* is a plain cylinder, the development of which has been explained earlier in this series.

To develop the pattern for *A:* First, draw the complete cone with apex at *D* and base line at 1-9. Second, draw the one-half bottom view, divide it into eight equal parts, from these points project lines up to the base line and then to the apex, *D*. Third, with 1-*D* as a radius, strike the arc *E-F*, get the correct length by setting off sixteen spaces from the bottom view as previously explained and draw radial lines to apex *D*. Fourth, from where the curved part of the scoop crosses the radial lines going up from the base line to the apex, draw lines over to line 1-*D* to get the true lengths as explained in the last issue. Swing these lines over on to the pattern until they cross the same numbered lines coming up from the arc *E-F*. Sixth, it will be noticed that the curve of the scoop in *A* does not cross the base line at the same place as one of the radial lines, so we must use an "auxiliary" line such as we have used in a previous problem. This is used in the following manner: From the point where the scoop curve crosses the base line, draw a line to the bottom view and mark it *X* as shown in the drawing. It can be seen that it lies between 4 and 3. Measure the distance from 4 to *X* and lay it off on the pattern arc *E-F* as shown. This will indicate the corner of the pattern. Do the same for the opposite side of the pattern, and the pattern for *A* will be complete.

Exactly the same method is used in developing the pattern for *B*. The steps are briefly indicated as follows: First, draw full cone. Second, draw one-half bottom view and run lines to apex *K*. Third, strike arc *L-M* with *K*-1 as radius. Fourth, draw lines from points where scoop curve crosses radial lines to line *K*-1, to get true lengths. Fifth, swing these lines in arcs to pattern. Make crosses where they intersect same numbered lines. Sixth, make use of auxiliary line *X* in exactly the same way as for pattern *A*. Connect the crosses with a curve and the pattern is complete. Make allowance for seams and wiring as previously explained.

Cutting Asphalt After Removing Metal Covering

ASPHALT is usually shipped in tin barrels. The metal is stripped off and the asphalt rolled up to the stopping board; the wire shown, attached to the



Cutting asphalt taken from barrel with a wire drawn through it with a windlass

winding drum, is passed over and around the asphalt to a piece of pipe under and ahead of the stop board. When the drum is turned it tightens up on the wire and causes it to cut through the asphalt. Kerosene is poured on the wire to make it pass through the asphalt easily.

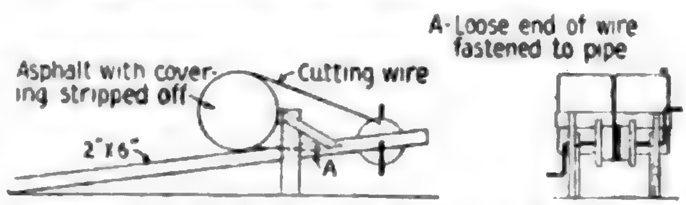


Diagram of the table, stop, and windlass for pulling the wire through the asphalt

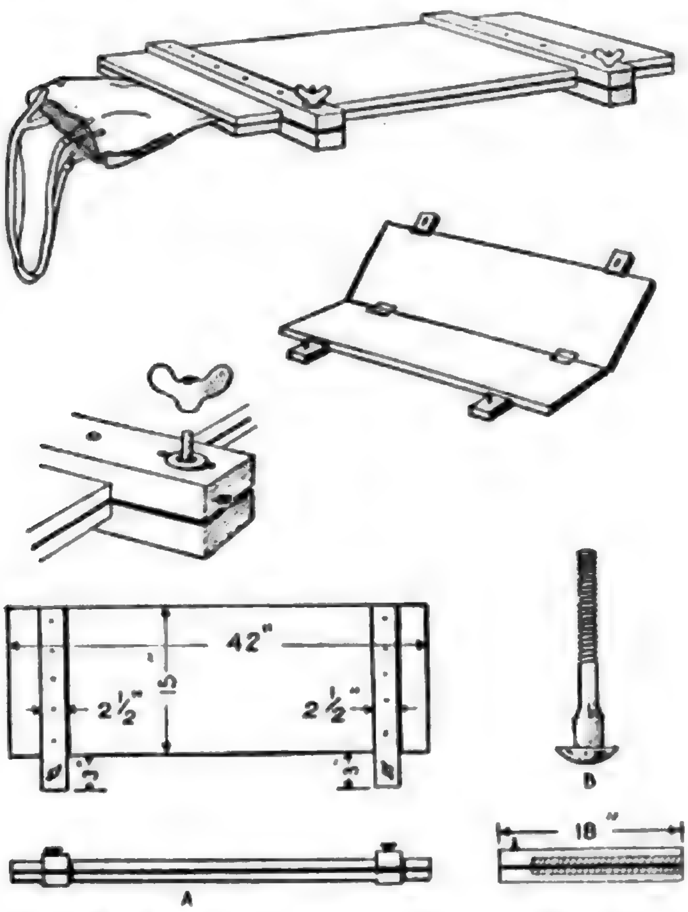
The barrel shape is first cut in half, then each half is cut into quarters which a man can handle easily. In warm weather asphalt is soft, therefore it cannot be cut or broken with an ax or other tool, so this machine is a time and labor saver.—GEORGE C. PECK.

Intensifying Under-Exposed Blue-Prints with Hydrogen Peroxide

AN under-exposed blue-print can be intensified by moistening its surface with a sponge dampened with peroxide of hydrogen. Old blue-print paper which would otherwise produce an indistinct copy need not be thrown away if treated with peroxide after the print has been exposed and "fixed."

Making a Simple Press of Boards for Trousers

WHY not let this simple board device press your trousers while you sleep? Two pine boards, cleated as at *A*, are hinged together, and the inside surface



Clamping your trousers between boards for creasing them by pressure overnight

covered with canvas. The latter is slightly dampened before the trousers are put in. The bolts, *B*, are tightened by means of wing nuts, which rest upon washers, as shown. Simply lay the article to be pressed flat and close the two sections of the press like a book. After the wing nuts are turned down tightly, the press may be hung up out of the way. Either clear white pine or cypress is suitable for making the press. Fasten with brass screws.—H. ADLON.

An Interesting Demonstration of Spontaneous Combustion

A VERY simple and effective demonstration of spontaneous combustion can be made as follows:

Dissolve a piece of yellow phosphorus, about the size of a pea, in a small bottle containing a tablespoonful of the liquid carbon disulphide. Pour the solution over a small, thin piece of porous paper. After waving the paper back and forth for about thirty seconds, it suddenly bursts into flame. The carbon disulphide quickly evaporates, leaving the phosphorus, in a finely divided state, spread over the surface of the paper. Since phosphorus oxidizes very rapidly and has a low kindling temperature, the heat of oxidation quickly brings it to this point with the result already described.

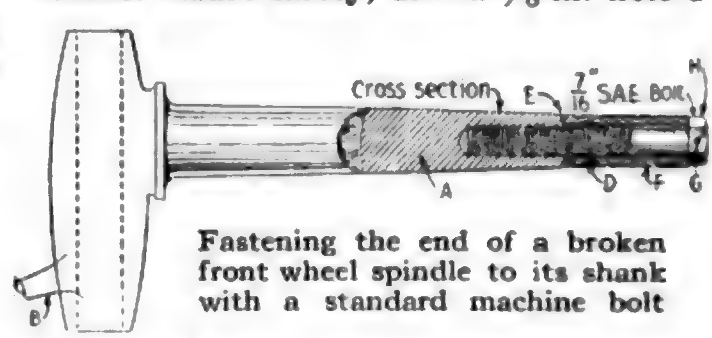
Phosphorus produces very severe burns and must be kept and cut under water. Do not handle it with the fingers—use forceps. Keep the carbon disulphide away from a free flame. If care is exercised, no danger attends this experiment. It is rather odoriferous, though.

Temporary Repair on a Broken Front Wheel Spindle

IF a front wheel spindle of an automobile, or any axle of a similar type, or a shaft or rod becomes broken, a semi-permanent repair may be made by the following method.

Remove the axle or spindle *A* by disconnecting the steering arm from *B* and removing the spindle bolt from the hole *C*. Place *A* and its broken member *D* in a clamp with the broken and rough edges *E* in their original places; then drill out a hole and tap it to receive a 7/16 in. S. A. E. bolt of sufficient length to be about equally distant from *A* and *D*. Do not tap threads in *D*, but ream to just sufficient clearance for the bolt.

Draw the bolt up snugly. The wheel may then be replaced after the spindle is connected. The outside cone is adjusted by the locknuts on the threads *F*. To further insure safety, drill a ⅛-in. hole *G*

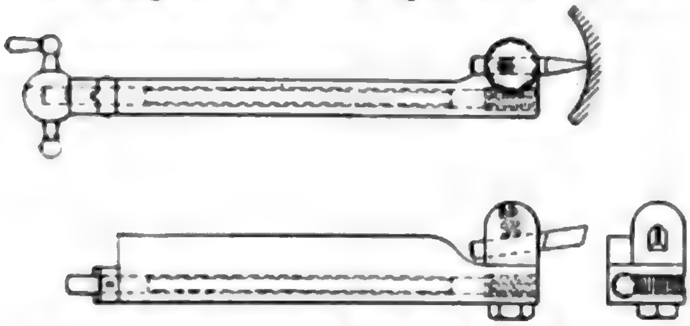


Fastening the end of a broken front wheel spindle to its shank with a standard machine bolt

in the bolt head *H* and insert a long cotter. The hub cap may then be replaced and the car used as before, or until a new part arrives.—P. P. AVERY.

An Adjustable Radius Turning Tool for Lathes

EVERY mechanic has at some time experienced trouble in making a true radius on a lathe. The tool illustrated, was designed for this special work and



A revolving turret on the tool which is controlled by a worm on the rod with crank

has proven a success, especially for tool room mechanics. The holder is made to receive the small high speed steel cutter in a revolving turret controlled by a worm on a shaft through the arm or tool post end of the holder. The shaft is turned by a small crank on the back end.

With this tool the stock may be roughed out, then turned to the radius for which it is set. The setting of the small tool in the turret determines the radius to be turned. This may be done by measuring from the tool point to the curved surface of the turret. Its diameter having been determined the exact radius may be easily obtained.—H. E. ANDERSON.

Protecting the Soles of Shoes with Ordinary Varnish

WITH the ever-increasing cost of footwear, it behooves the user to get as much service from his shoes as possible. To do this the leather must be protected. The soles are the first to suffer, but if the uppers are not impervious to water they will get damp even when the walks are not very wet, and will eventually crack.

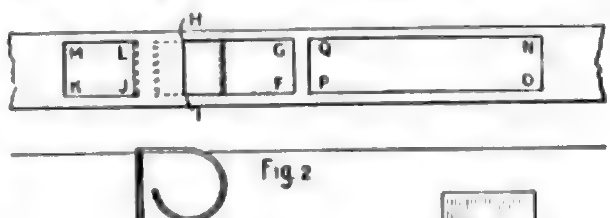
Chamber's Journal is responsible for an article describing how to apply an inferior type of copal varnish to the soles to keep out the water.

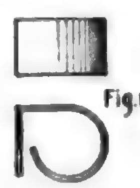
The leather must be quite dry and bare when the varnish is applied. New boots should therefore be worn for a day before treatment, so as to remove the black varnish from the soles. The operation is carried out by brushing on the varnish at intervals of half an hour, until the leather will not soak up any more. This condition may be recognized from the surface remaining shiny all over, instead of becoming dull in places. After being hung up to dry for about twelve hours the boots are ready for wear.

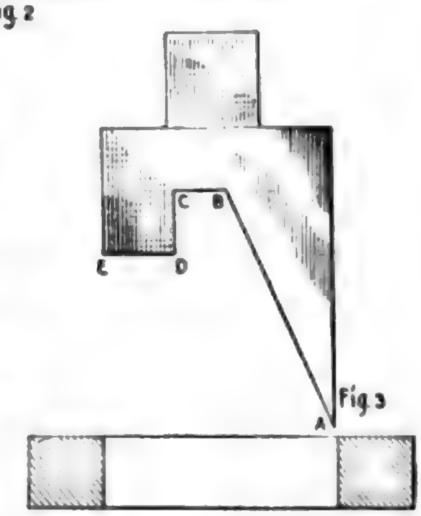
A Metal Clip Formed with One Die and One Operation

DUPLICATE parts are quickly made in a punch press by several operations, but how many persons would think that a piece like the one shown in Fig. 1 could be made with one tool in one operation? Such a shaped piece of metal is used as a catch on breast pins, class pins and similar jewelry. The clip is cut and formed from a strip of metal as shown in Fig. 2.

The punch and die for punching and shaping the metal are shown in Fig. 3. The die consists of a piece of steel with a rectangular hole cut in it the width and length necessary to bend the metal in the shape shown. The punch has a







The shape of the tool forms the clip as it is cut from the metal

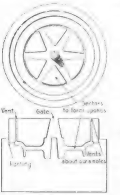
wedge-shaped point *A* which punctures the metal first, cutting along the line *F-G* in Fig. 2. Then as the surface *A-B*, Fig. 3, enters the metal, it cuts along *F-I* and *G-H*, Fig. 2. As the punch cuts these edges, the metal rolls into a curve. The part *D-E* on the punch, Fig. 3, cuts the metal along the lines *J-K*, *K-M* and *M-L* and bends it in the line *J-L*, Fig. 2, then when the part *B-C*, Fig. 3, reaches the metal it cuts out the remainder, leaving the holes *N-O-P-Q*, Fig. 2, in the metal,

and the blank is formed up as required.

The inclination of the slant determines the diameter of the rolled part. Even with the small portion of material wasted, the saving of time in making the parts makes this way an improvement on the old method of cutting them from ribbon stock and forming them in two operations.—S. B. ROYAL.

A Wood Mold for Casting Miniature Car Wheels

TO make a number of cars with which to equip a miniature railway, many wheels just alike will be required. To cast these from metals of low melting temperatures in sand molds, it is necessary to make a great many of them. If care is not taken they will come out rough and will need more work to prepare them for use on the cars. The mold illustrated is one that can be used over and over again. It makes castings all alike and turns them out nicely finished, ready to assemble. The mold is turned in a close-grained piece of hardwood; in the end grain. Two pieces are necessary and the drag or bottom part should be turned with a ledge, and the cope or upper part should be turned to fit in it as shown at the parting line. These surfaces, when turned at the same time that the mold is made, will cause a perfect [illegible] ing of the parts for each [illegible] metal.



Mold of wood to cast wheels of babbitt metal

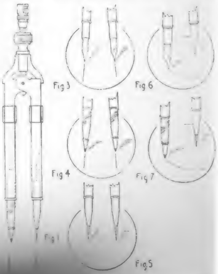
The gate should be tur[illegible] that the larger part [illegible] This will make i[illegible] be removed [illegible] be formed b[illegible] the right [illegible]

A [illegible] made in [illegible] the [illegible] wheel is cast, it only has to be reamed out in order to fit the axle. The draft given to the mold forms the right slope to the wheel surface for rolling on the track. —HENRY WEDDE.

Compasses Made Into a Combination Drawing Tool

PERSONS who do considerable drawing or lettering, sooner or later find the so called railroad pen and railroad pencil an absolute necessity. These are expensive tools, however, and an excellent substitute may be produced cheaply.

Procure two of the compasses such as are here shown and use one pair complete. Pull the points out of the other compass and lay the body away for future use in case of breakage. The points are the only part of the extra pair needed. With



Making five different com-[illegible]tions with one compass

[illegible] of one pair of [illegible]s and the four [illegible]ve different com-[illegible] are available. [illegible]n have a railroad [illegible] railroad pencil, [illegible]mpass and pencil [illegible] in the illustrations. [illegible]y be done with this [illegible]RT E. JONES.

Open Canoe Cruising

I.—This article describes the open, canvas-covered canoe, its economy in first cost and maintenance and its all-around possibilities as a paddling, cruising and sailing craft

By E. T. Keyser

THESE wartime days have impressed many with the fact which a comparative few realized years ago: that the ability to travel comfortably with light equipment, to keep dry and comfortable in wet and cold and to be able to cook a meal quickly and easily with little fuel and few utensils is an accomplishment.

And this accomplishment, which it is costing Uncle Sam months of time and thousands in money to teach his recruits, is what his first season of cruising gives to the canoeist.

The open canvas-covered canoe, considering its carrying capacity and cruising ability, is, both in first cost and in maintenance, the most economical craft built. It can be purchased so cheaply that it is hardly an economy to build one's own.

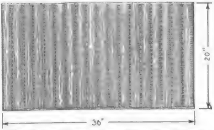
Give it a coat of varnish each season, and a little paint each alternate year and the canoe is good for an indefinite length of time.

For an afternoon on the water, it affords more enjoyment than a row boat, as the paddler can see his course ahead without the neck-twisting process required of the oarsman. As a cruiser, it will go almost anywhere that the small launch or sailboat can navigate and into many nooks and waterways where neither may venture without grounding. As a sailing craft, it affords all the sport and excitement of the small yacht at a fraction of the expense

For all-around paddling and sailing, sometimes single-handed and sometimes with a companion, a 17-ft. canoe is the best. For a small boy who cruises alone, a 15-ft. craft is better because it is easier to handle under paddle in a beam wind, [illegible]le for continuous double cruising on [illegible]rs where carriers are absent, 18 ft. [illegible]t too long. Generally speaking, [illegible]er, the 17-footer has been found to [illegible] best all around canoe. It is large [illegible] to accommodate a crew of two [illegible]r camp outfit, but it is not too large for one man to pull above high water mark, and it is of sufficient size to carry a satisfying sail area distributed in a double rig.

A model with a little deadrise (that is a midship section coming down to the keel in a slight "V" shape) holds up to the wind better and at slight sacrifice of cargo carrying capacity, as compared with the flat floored model.

By all means choose a canoe with an outside keel which takes the wear and tear which the canvas covering would otherwise receive when beaching the boat or pulling it on and off the float. If possible, see that the craft has wide outside



Two layers of canvas sewed together in parallel lines making pockets for cork filling

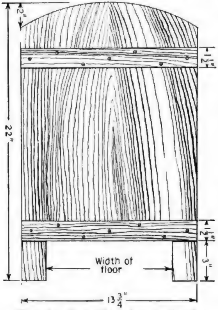
beveled gunwales which throw off a choppy wave that would otherwise climb aboard.

On a 17-ft. canoe, 15-in. decks at each end are long enough. Longer ones add to cost and weight and decrease the seating and stowage space while adding very little to the weatherlines. An open woven seat, 10 in. wide at the bow and one at the stern, should be hung just below the gunwales; this allows one to sit with the knees at a comfortable angle. Some builders drop the seat lower, claiming increased stability, but the first lesson which the canoeist should learn is that seats are to be used only in calm weather. When things rough up one should get down on the floor cushion.

Paddles are made in two general types,

single and doublebladed. Better choose the double blades, square ended, well coppered and 9½ ft. long. They are joined at the center with a heavy ferrule and any time that you want to try single-bladed stunts, separate them and you have two single blades, which will be more comfortable if you have provided yourself with a pair of the short separable handles which the paddle-makers turn out to keep your hands from getting cut and cramped on the ferrule edges.

With the double blade there is no



Dimensions for cutting a board and making a back rest for the seat of a canoe

waste motion, the finish of one stroke places the other blade in position for the next, while with the single blade a recovery stroke must be made. With two singles, unless the paddlers are well matched and practiced in keeping each other's stroke, the rear paddler wastes much energy in keeping a straight course, while with two double blades each paddler equalizes his own strokes automatically.

But the great advantage of the double blade lies in the ability of one man, when paddling against or across a breeze, to head the canoe direct for her destination, without loss of time in recovery or loss of energy in the back sweep required to offset the tendency of the craft to turn in the direction opposite that from which the paddle is operated. In running into a wind, against which one paddler with a single blade would be almost helpless, the setting of the blades at right angles to each other reduces the windage of the idle blade to almost nothing, and a little practice will allow its being turned to take the water without conscious effort. The double blade may be used from the seat or from the floor position, while to get any action from the single blade, the seat position must be kept.

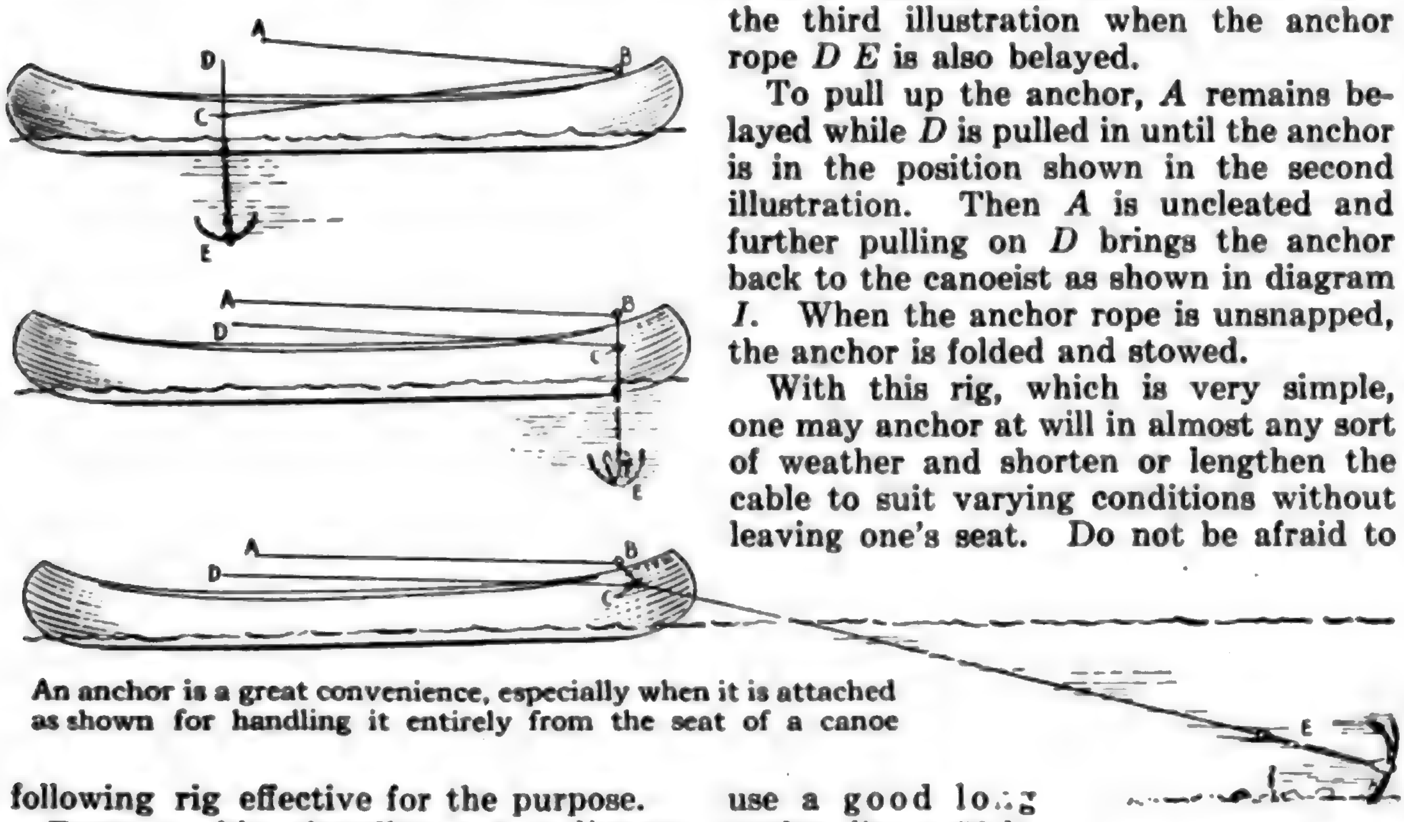
For each cushion purchase one yard of light weight brown waterproof canvas, 40 in. wide. Fold this over on itself with the fold running the long way. Sew the two ends together by machine, if possible, then parallel with the ends and 2 in. apart, stitch across the short way, stitching the two thicknesses of canvas together, being careful to leave the ends of the compartments open so that they may be stuffed with ground cork. When full, baste the open ends together and finish the job on the machine.

You now have a cork-filled waterproof cushion, a trifle less than 20 in. wide and somewhat less than 3 ft. long. Fold this over on itself lengthwise and the result is a canoe cushion about 4 in. thick, which keeps you high enough to be comfortable, does not get wet through readily and, when moist, dries quickly in the sun.

The thwarts are rather low and somewhat too thin to furnish a comfort-support, so you need a couple of back rests. The simplest ones are those cut from ½-in. cherry or chestnut, 22 in. long by 13¾ wide, as shown in the illustration. Be sure that the grain of the wood runs from top to bottom instead of across the back rest, and that the space between the feet is sufficient to clear the flooring strips. Two strips of the same material, each 1½ in. wide, fastened across the back with brass screws will prevent warping if a couple of coats of varnish are applied.

A painter or bow-line with which to tie the canoe is a necessary part of the equipment. An anchor which will allow you to fish or to lie to in some quiet cove without going ashore is also a great convenience. A four-pound folding anchor of the

"Dirigo" pattern will hold the canoe against a strong current or breeze and when folded has no projecting points upon which to step or which will puncture the planking. You cannot walk up to the bow to hoist the anchor as you could aboard a rowboat, but I have found the following rig effective for the purpose.



An anchor is a great convenience, especially when it is attached as shown for handling it entirely from the seat of a canoe

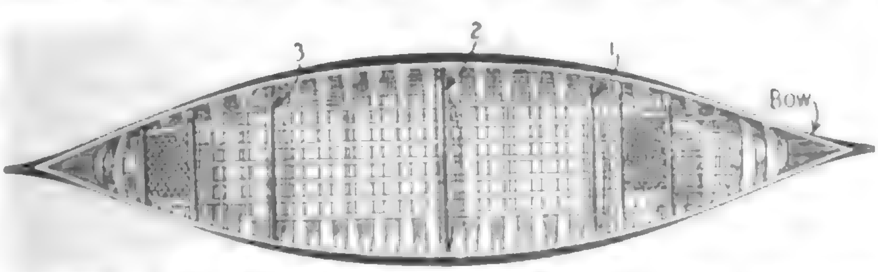
From a ship chandler, get a *lignum vitae* bull's-eye with an eye diameter of ½ in. Then get a brass screw-eye whose interior diameter is that of the outside diameter of the bull's-eye at the bottom of the groove which surrounds it. Using a cold chisel, carefully open the screw-eye sufficiently to insert the bull's-eye, then with the aid of a vise, seat the screw-eye firmly in the groove of the bull's-eye. Set this device crosswise in the center of the forward deck and run a ¼-in. cotton rope through it, the rope's length should be twice that of the canoeist's distance from the bow when occupying the rear seat. This is shown at *A. B. C.* At *A* tie a knot which can not pass through the bull's-eye, at *C* fasten a galvanized snap hook through which the anchor line runs easily.

Holding one end of the short line at *A*, the canoeist snaps the galvanized snap *C* over the anchor line, *D E*. Then pulling in on *A*, he allows *D E* to pay out until the anchor is at the bow as shown in the second illustration. Then *A* is belayed to a cleat and *D* payed out until the anchor rests on the bottom as in the third illustration when the anchor rope *D E* is also belayed.

To pull up the anchor, *A* remains belayed while *D* is pulled in until the anchor is in the position shown in the second illustration. Then *A* is uncleated and further pulling on *D* brings the anchor back to the canoeist as shown in diagram *I*. When the anchor rope is unsnapped, the anchor is folded and stowed.

With this rig, which is very simple, one may anchor at will in almost any sort of weather and shorten or lengthen the cable to suit varying conditions without leaving one's seat. Do not be afraid to use a good long anchor line,—50 ft. will be none too long—and will allow the anchor to hold against a current or breeze which would cause the canoe to drag if a shorter cable were attached.

On calm waters, in calm weather, or with a moderate stern breeze, a single-handed canoeist with no luggage aboard, should turn the canoe stern first and sit on the bow seat facing the stern which is now the bow or on a cushion leaning against thwart 1. From either position the canoe trims well with but one man aboard, the chance to change from one position to the other at will is very restful and adds greatly to one's endurance on a fairly long run



Layout of the ordinary canoe showing the relative positions of the seats and the thwarts. Seats are for calm weather use

When running into a strong breeze or with a quartering wind, which catches the bow and swings it around, sit in front of

thwart 3 facing the bow. When the wind becomes heavy and almost all one's energy is required to keep the canoe on her course, crawl forward in front of thwart 2. This allows the stern to rise up and, by catching the force of the wind, to act as a weathervane, making the canoe tend to point into the wind of her own effort, releasing all of the paddler's strength for use in making progress forward.

I would not suggest that a canoeist should deliberately start out on a long hike against a heavy wind or with a quartering gale blowing, but weather conditions sometimes change without notice, and this scheme proves mighty helpful when one does get caught.

Progressive positions of single blade paddle

With two aboard, use the canoe bow first, sitting on either the seats or the floor as desired, the heavier person occupying the after position. If weights are about equal, the better paddler should sit aft.

The bow seat is best for a woman when she is one of the crew, as she can paddle and rest, rest and paddle as she sees fit without interfering with the management.

In fairly rough water one can run directly ahead of rather high waves without discomfort, if careful not to let the canoe swing from her course and get into the trough. Surprisingly high waves may be run into bow first, if the speed of the canoe is checked enough to reduce plunging the bow under the white caps. A heavy beam wave is bad. It has a tendency to slap against the side and slop aboard. Therefore it is better to hug a windward shore when possible or, if in open water, to make a series of tacks, the same as if sailing, first quartering against and then from the waves.

What has been said in regard to speed reduction when meeting bow waves in open water is still more true when one is running rapids in streams or going through tide rips. In both these latter cases, the water itself and not the *form* of the wave is what advances and, unless the canoe is allowed but just enough speed for steerage way, there will be a strong tendency for the bow to ship water.

In discussing the paddle, emphasis has been placed on the desirability of the separable double blade. There are times, however, when the canoeist will desire to separate it into singles, so a word regarding its handling will fit in here.

With two paddlers, each using a single, it is the part of the stern man to keep the course, which may easily be accomplished if both are able to match each other's stroke. Otherwise the rear paddler wastes effort in keeping up his end or retarding his stroke to match the bow paddler's.

With one paddler only, using the single blade, a peculiar stroke is necessary to maintain a straight course without shifting the blade from one side of the canoe to the other as shown.

The arrow shows the direction of the stroke while the dotted arrows indicate how the outside edge of the blade is turned as the stroke finishes.

For a little more than one-half the stroke, the blade remains at right angles to the canoe, then the outside edge is brought forward gradually swinging the blade into the last position shown, which swings the canoe in an opposite direction from which the commencement of the stroke points it

As will be seen, the first part of the stroke furnishes the power to send the canoe ahead, the latter portion is devoted to converting the swing of the canoe from a left hand into a right hand direction, and has very little propelling power. As one becomes more expert, the entire stroke may be taken with just enough angle to the blade to offset the natural swing of the canoe away from the paddle, and one may make the canoe describe a circle, the center of which is on the side on which the paddle is used. The diagram illustrates the movements when the paddle is used on the right hand side of the canoe; when the paddle is used on the left side the turning of the blade is reversed.

Before closing this chapter on handling, I want to register a few emphatic "Don'ts." Don't step anywhere but in the center of the floor when entering or leaving the canoe. Don't rest part of your weight

on a float or dock and part on the gunwale when getting on or off—rest your weight equally on both gunwales. Don't stand up in the canoe. If you must change your position while afloat, rest your weight on both gunwales, keep low down and slide to your desired place. Don't try to paddle from the seats when it begins to get rough—get down on the floor and get there gently. Don't leave the canoe exposed to sun, rain and wind, keep her under cover when not in use.

(To be continued)

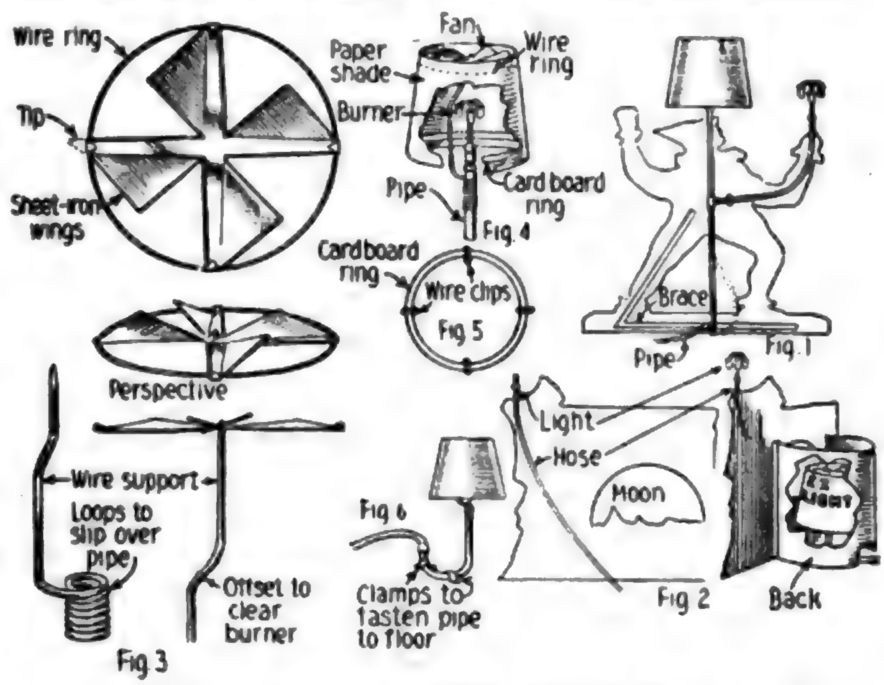
An Attractive Heat-Driven Window Display of Gas Fixtures

NOT long ago an establishment dealing in gas fixtures, displayed in its window a gaily colored pasteboard clown holding in one hand a well-known type of gas light, while apparently balancing on his nose a lighted lamp, the colored shade of which revolved continuously. A back view of the figure showing the piping and wood braces is displayed in Fig. 1. A gas hose from a convenient stop and connected to the brace pipe, furnished the illuminant and motive power.

The latest window display, advertising this same light, is more spectacular than the first. Standing at one side of a moonlight scene, showing a large moon rising back of the house tops, stands a gaudily dressed Oriental, who points toward the face of the moon, across which illuminated words move constantly. In each display, the ascending current of hot air, generated by the gas light, is the motive power. The mechanism is just an adaption of the old hot air wheel the boys used to hang over the cook stove.

The wings are attached to a wire ring, Fig. 3, which is slipped into a deep paper shade, fitting into the shade snugly near the top as shown in Fig. 4. The bottom of the shade is kept in shape by a cardboard ring secured with wire clips which pass through the shade. See Fig. 5. A wire support, looped at the bottom to slip over the gas pipe, supports the wheel and shade. A small depression in the exact center of the wheel fits over the pointed end of the wire support. Point and depression are gaged to a nicety as is evidenced by the even balance and smooth movement of the shade.

The display just described requires the lamp to be concealed by a semi-circular black cardboard screen. This cuts off the light except at the top and front. The light, projecting through the cut-out, words in the shade, glows through the tissue paper face of the moon, and the colored design on the shade produces an effect of moving clouds across the face of the moon. As in the clown display, the light advertised is also prominently shown.



A heat-driven wheel for turning lettered signs and the arrangement for illuminating the parts of the scene

Methods of anchoring the lamp, also a rear view of the display, are shown in Figs. 2 and 6. Judging from the improvement in the second display, the use of gas generated hot air, and the simplicity of the mechanism necessary to utilize it, offers a wide field for attractive window displays.—JAMES M. KANE.

Permanently Fastening Joints Held with Screw-Unions

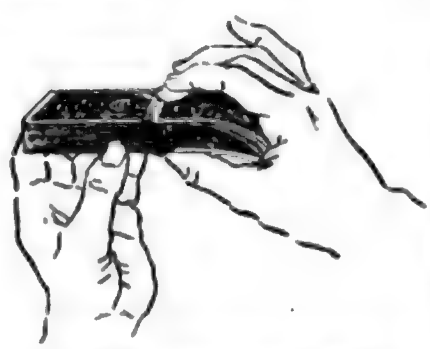
IF you desire to fasten pipes or pipe fittings together permanently, thoroughly clean the parts to be fastened and cover the threads with a strong solution of salt and water. The salt will rust the threads together, fastening the parts.

Little Ways in Which You Can Save Gasoline

DO not use gasoline for washing or cleaning; use kerosene. Do not allow your automobile engine to run when car is standing. Have your carbureter adjusted to use leanest mixture. See that bearings run freely and are well lubricated. Keep tires fully inflated. Protect the radiator in cold weather. Change gears rather than climb hills with throttle wide open. Do not use your car needlessly or aimlessly. Do not do stunts.

Discovering a Card Chosen but Not Taken from the Pack

FIRST notice the bottom card, then take the pack in the left hand, holding it with the fingers on one side and the thumb on the other. Secretly draw down the bottom card about ½ in. Let the right hand approach the pack, and with the first and second fingers draw down the cards, one by one, ½ in., beginning with the top card and so on, inviting your audience to stop you at any card they choose. This is clearly shown in the illustration. The thumb of the right hand has remained beneath the pack in contact with the bottom card. The thumb should have been previously moistened slightly so as to adhere to the bottom card. When your audience has indicated the card at which they desire you to stop, draw all the cards so far selected completely away from the pack, drawing with them also, unknown to the audience, the bottom card. If this is done quickly it is impossible to detect that the bottom card is drawn away with the upper cards. Since, however, you know the bottom card, you can disclose it at your leisure by some means or other. It is needless to say that the bottom card is really supposed to be the last card at which you stopped in going through the pack.



Secretly draw out the bottom card a short distance

The effect of the foregoing trick may be greatly enhanced by shuffling the pack after having noticed (secretly, of course) the bottom card. This apparently does away with any previous arrangement. The object of the shuffles is to leave the pack, or certain cards in it, exactly in the same position as they were before. Shuffles of this kind, which leave certain cards undisturbed, are known as false shuffles. There are many ingenious methods for shuffling a pack in this manner; but for this purpose two methods are described which leave the bottom card still at the bottom, or the top card at the top.

Take the pack in the left hand in the ordinary way and shuffle it with the right, leaving a number of cards alternately at the front and rear of the pack; that is, leave some at the top, then some at the bottom, again some at the top, and so on, taking care that the last batch shall always be at the bottom of the pack. This will always leave the bottom card at all times in its original place.

Another method is to divide the pack into two equal parts, being careful that the card known to you is on the bottom of one of these packs, and keeping in mind which pack has this card. Lift the corners of the two packs and let the cards fall alternately as nearly as possible, the corners overlapping, so that, when the shuffle is finished the two packs form one pack. The only thing to watch closely is to see that the card known to you falls on the table first. This leaves that particular card at the bottom of the pack.—HEREWARD CARRINGTON.

Rejuvenating the Ribbon on an Adding Machine

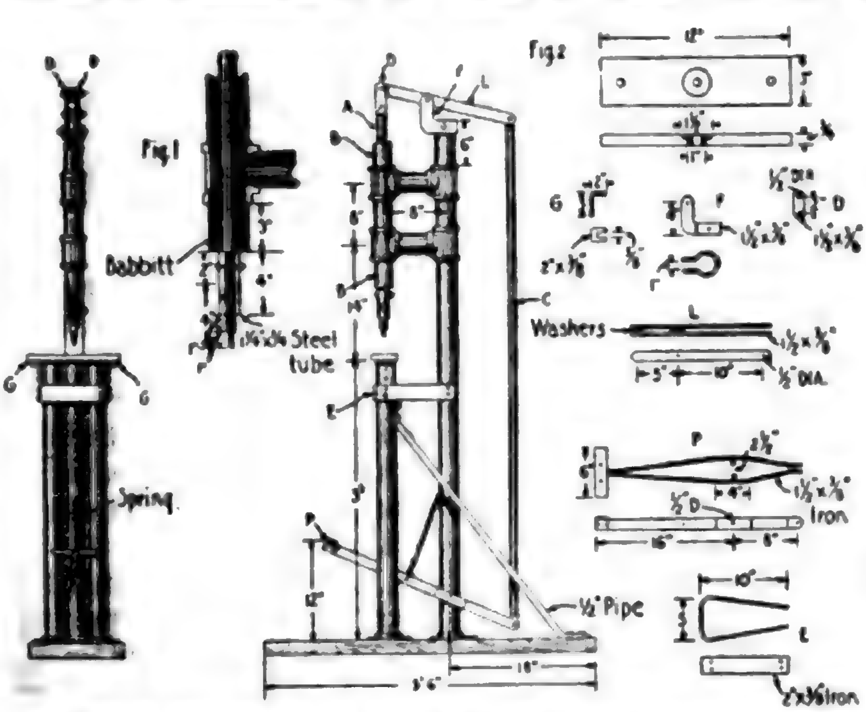
THE writer was unable to secure, without considerable delay, the proper bichrome ribbon for an adding machine. The one in use, though not badly worn, was too dry to give a satisfactory impression. As the fresh color of the ribbon indicated that the pigment was still in the fabric, it was decided to see if an application of oil would not loosen it up. This was tried, and after two or three applications of machine oil the ribbon worked as well as ever and continued to render good service for several months.

Tricks of the Trade

An entire homemade punch operated by foot power. How to make laminated wood pulleys

A Foot-Power Punch Press for Light Work

THIS foot-power punch press was made almost entirely of 2-in. pipe and fittings, built on a wood base 2 in. thick, 12 in. wide and 3½ ft. long. The ram *A* consists of a piece of 1-in. cold rolled steel 2 ft. 1 in. long. The bushings *BB*, in which the ram works, are short pieces of pipe lined with babbit, as shown in the detail Fig. 1. The end on which the socket is fitted is turned to a diameter of ¾ in. The socket is made from a piece of steel tube 1½ in. in diameter with walls ¼ in. thick. The punch is turned from tool steel ¼ in. in diameter to the required size, leaving enough shank full size to fit in the socket. The punch end is then tempered. The connecting arm *C* between the foot lever and the lever at the top consists of a ½-in. pipe flattened on the ends to fit between the parts of each lever. This piece is measured and fitted into place after the other parts have been assembled. The foot lever should be 12 in. from the base when the punch is raised as high as it will go in the bearings.



Punch press made of pipe and fittings, which are set on a wood base. The punch is operated with a foot lever

The die, Fig. 2, is made of a good grade of iron and fitted with a hardened steel bushing. Several of these bushings may be made with holes of varying sizes so that when the punch sizes are changed the bushing to match them may be changed also.

If it is desired to use the punch on large sizes of metal it will be necessary to make the die and holder in one piece, and of hardened tool steel. The die is securely fastened in the die-holder with two ½-in. cap screws which fit into slots in the angles *GG*.—C. A. BUTTERWORTH.

Homemade Laminated Pulleys for the Small Shop

IN practically every shop cone-pulleys and plain pulleys are needed at some time or other, but for the mechanic of ordinary means they are expensive to buy. They can be turned from solid blocks on a lathe, but a lathe is not always available and even then the cost is considerable. By the following simple method pulleys which will not warp or split, and which will give as good results as the expensive pulleys, can be made at practically no expense.

Thin wood is easy to get and is easy to cut, and from this the pulleys are made. Hard wood should be used if it can possibly be obtained. On a scroll saw, cut the wood into circles a little larger than the size of pulley wanted. Cut enough disks to build the pulley up to the right thickness. In each disk, drill a hole for the shaft, which should fit tightly.

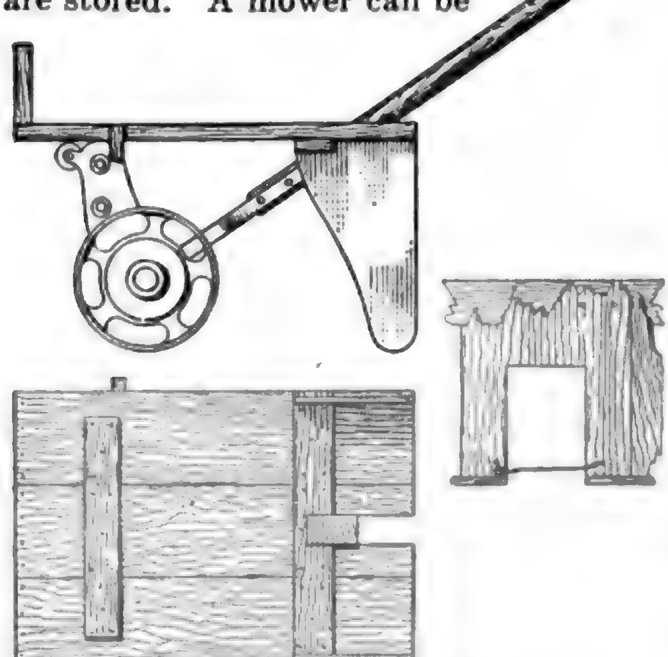
Glue the disks together with the grain of each running in a different direction; allow a little extra thickness for truing up afterwards. Be sure the surfaces to be glued are free from all dirt and grease. Use good glue; if the common kind is

used, it should be applied while it is very hot. Clamp the disks together with stiff blocks and heavy bolts, putting one bolt through the shaft hole and several around the outside. The bolts should be tightened as much as possible so that the disks will be pressed together very tightly. Allow the glue to dry for at least twenty-four hours in a warm—not hot—place. Put in screws, countersunk from both sides for additional strength and to prevent the glue from loosening. The pulley can be trued up when running on its own shaft. Make the belt face of the pulley slightly crowned, because if the face is flat, the pulley will run off. The surface should be made as smooth as possible, as the smoother it is the better the belt will hold.

The only difference between making a cone pulley and a plain one is that the steps are made separately and then glued or screwed together.

A Lawn Mower Converted Into a Handy Truck

LAWN mowers serve their original purpose only about four months of the year. During the remainder of the year they are stored. A mower can be



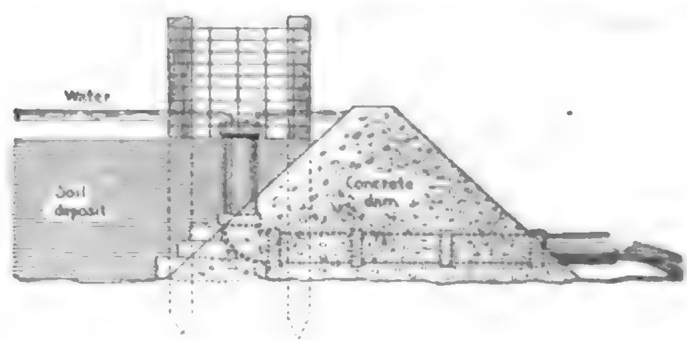
An inverted lawn mower equipped with a board platform to make a truck for small loads thus making it useful in the winter

made to serve two purposes with the board attachment shown. It is well known that pushing an inverted lawn mower throws the gears out of mesh. The board attachment may be easily made and put on the inverted mower so that it may be used for hauling small loads or sacks of grain.

The size of the board depends on the size of the mower. The manner of attaching it to the inverted mower is clearly shown.—EARL R. GASKILL.

A Dam to Prevent Top Soil from Washing Away

A SIMPLE and inexpensive method of preventing a field from becoming cut up by gullies is shown in the drawing.



Cross section view of a small concrete dam which keeps the soil from washing away

Some lengths of sewer pipe and a few hours work in the building of a small concrete dam across each gully is all that is required. The drawing shows how the dam operates.

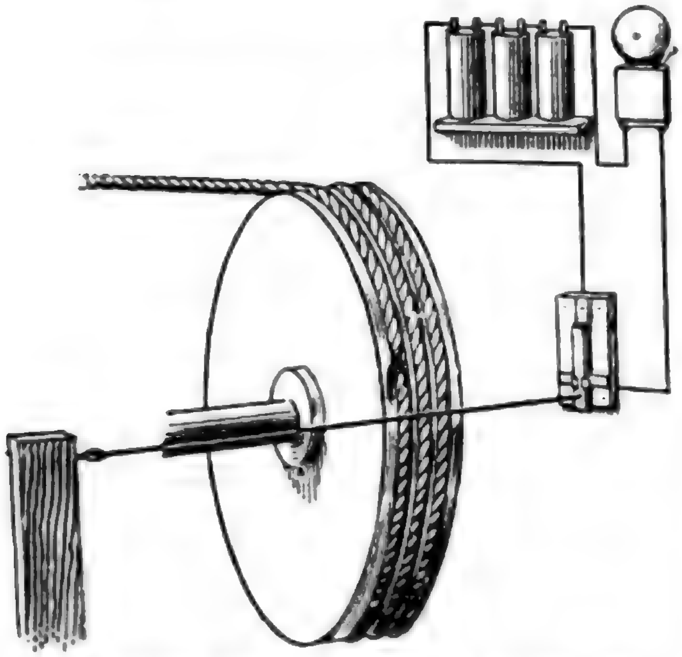
It is a good plan to set three or four posts around the opening or the inlet and then wrap them with common mesh fence wire so that all rubbish and trash will be kept out of the sewer pipes. In laying the pipe be sure and set the curve or elbow on a firm bed of stones and also be sure that the whole length of pipes is on a solid footing.

The concrete dam is preferable although hard clay has been used for small places. The dam catches the top soil washed from the fields and also stores up the surplus water. The richest part of the soil is the part that washes away during heavy spring rains. Some practical method of preventing this great loss is well worth the farmer's attention if the producing power of the fields is to be conserved or increased, and the method of surface drainage suggested above is at once practical, simple to install, inexpensive and effective.—W. E. FRUDDEN.

The Amateur Electrician And Wireless Operator

Electric Alarm Signal for Transmission Ropes

TRANSMISSION ropes in continual service eventually wear so that a break begins. The simple electric device shown sounds an alarm as soon as the first strand breaks, or begins to unravel. Immediate repairs can be made before the break becomes a serious one that would necessitate a new rope.



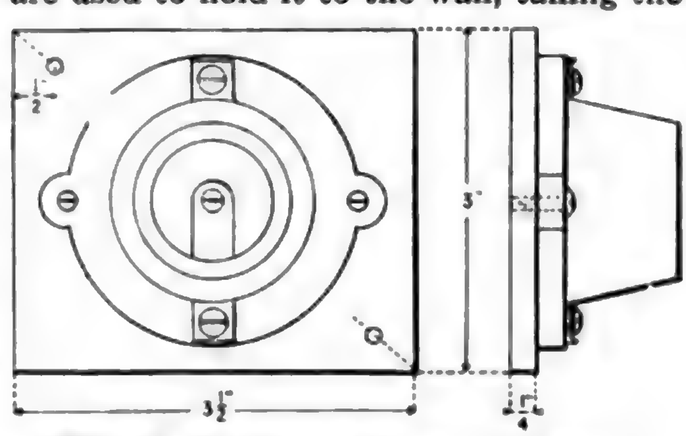
A broken strand in the rope strikes the wire and makes an electric contact

To Prevent Leather Belts from Slipping on Pulleys

IN the machine shop, slipping belts are a source of constant annoyance, and tightening does not always remedy the difficulty. Powdered resin is bad for the belt, though unfortunately it is widely used. Its tendency is to dry and crack the leather. In place of resin, whiting can be used. Sprinkle it sparingly upon the inside of the belt. Continued use of this substance has demonstrated that it is the least harmful application. Resin is difficult to get out of the leather; whiting may be wiped off or washed out with water. The best results are obtained when the whiting is applied once a week. A frequent cause of slipping is the failure to lag the iron pulleys with a covering of leather. If this detail is attended to, it will, to a great extent, do away with slipping.

Mounting a Porcelain Base Electric Light Receptacle

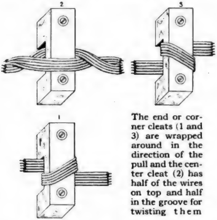
EXPERIMENTERS and students who are using porcelain receptacles for experimental and practice work, find that they very often break off the porcelain lugs which are used to hold the receptacle to the wall. A very good and cheap method of eliminating this waste is to mount the receptacle on a piece of 1/4-in. fiber, 3 1/2 in. by 3 in., with 8-32 machine screws, as shown in the illustration. The two holes in the corner of the fiber base are used to hold it to the wall, taking the place of the holes in the porcelain. In this way, the receptacle is guarded against breakage.—WALTER B. WEBER.



With the fiber base attached the porcelain socket is protected from breakage

Tightening Electric Wires Under Wood Cleats

EVERYONE realizes how difficult it is to tighten a number of wires under wood cleats. Using the method shown in the illustration, it becomes a very simple matter. The wires on the end or corner cleats of a run should be wrapped around and securely fastened to the cleats. The center cleat should have one-half of the wires on top and the other half in the groove. The cleat is then turned round and round until the wires become a tightly twisted cable. Care must be taken, however, not to stretch the wires too much as it is possible to break them. The cleat is then screwed down, holding the wires in this tight cable-like form.



The end or corner cleats (1 and 3) are wrapped around in the direction of the pull and the center cleat (2) has half of the wires on top and half in the groove for twisting them

Mounting a Glass Plate Without Drilling Holes In It

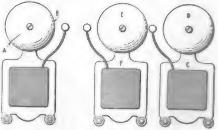
THE method herein described for mounting a glass plate is much simpler than drilling, and in most cases it is to be preferred. The procedure may be utilized by the amateur for plates not having a greater diameter than 2 ft.

To mount the plate, it is necessary to place it upon marked paper that has been made for template, to enable one to determine the center. Over the center must be pasted small circles of a fibrous brown paper, one on each side of the glass. The circles must be exactly the same size as two wooden cheeks previously made from a cotton reel sawn in half. The paste essential for satisfactory results contains the following ingredients: One teaspoonful of flour; two ounces of water; and three grains of bichromate of potash. The potash should be finely pulverized, and the ingredients must be thoroughly stirred before placing them over a flame. The mixture is brought to the boiling point in a suitable vessel. It is kept in the dark when not in use. The glass disk on which is pasted the paper circles, is placed in the sun for a few hours. This treatment insures the best result as the sun's rays set up a chemical action in the bichromate, rendering it insoluble, so that it cannot readily be detached from the plate. When dry, the wooden cheeks may be glued to the paper circles. First add a few grains of the potash to the glue to prevent its being affected by dampness. A little care will secure excellent results.—HERMAN NEUHAUS.

Changing the Tone of an Electric Bell by Sawing It

A VERY good method of changing the tone of a bell is to saw a slot *A* in the gong *B* with a hack saw; the bell will then have a tone similar to that of a cow bell. The deeper the slot, the duller the tone.

Another method of changing the sound of a bell, is by placing two bells close together so that the hammer of bell *C*, on its forward stroke, strikes the gong *D*. On its backward stroke, *C* strikes the gong *E* on bell *F*, making it sound like a telephone bell. When bell *F* is rung, the hammer only hits its own gong, giving the ordinary sound.



Changing the tone of a bell by sawing a slot in the gong and a double gong arrangement, thus distinguishing them

Electrical Devices and How They Work

IV.—Theory and Fundamental Principle of the Condenser

A condenser consists of a material that has the property of holding a charge of electricity

By Peter J. M. Clute, B. E.

IF a metal plate *A* is mounted on an insulated stand and connected with an electroscope, as in Fig. 1, and if another plate *B*, similarly mounted, is connected to the ground, then, when an electrostatic charge is placed on *A*, it will be

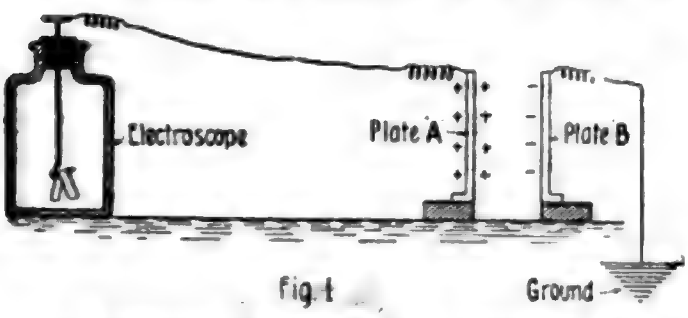


Fig. 1

A diagram illustrating the action of an electrostatic charge between two plates

observed that the leaves of the electroscope collapse as *B* is brought close to *A* and diverge farther as *B* is moved away from *A*. This merely shows that the potential of *A* is lessened when the distance between the plates is diminished, in spite of the fact that the quantity of electricity on *A* has remained unchanged. If additional charges of positive sign are conveyed to *A*, it will be found that many times the original amount of electricity may be placed on it when *B* is in proximity to it, before the body regains its original potential.

It can be stated, therefore, that the capacity of plate *A* for retaining electricity is very greatly increased by bringing near it another conductor connected to earth. It is evident from this statement that the capacity of a body is measured by the amount of electricity that can be put upon it in order to raise its potential to a certain point. Under these circumstances the charge on plate *A* is said to be bound by the opposite electricity on plate *B*.

An arrangement of this sort consisting of two conductors separated by a nonconductor or dielectric, as air, mica, rubber, or paraffined paper, is called a condenser. When the conducting points are very close together and one of them is grounded, the capacity of the system may be thousands of times as much as that of a single plate. If these two plates are connected to the two terminals of a battery, or other source of electrical energy, as shown in Fig. 2, they acquire equal and opposite charges of electricity, corresponding in sign to the terminals to which they are connected. The final constant difference in potential between the two plates is that of the two terminals; or, what is the same thing, each plate assumes the potential of the point to which it is connected. If the leads to the condenser are of negligible resistance, this difference is produced almost instantaneously, that is, the condenser charges in a negligible time.

The flow of current will be at its maximum at the instant the E. M. F. is applied, but will rapidly fall off, so that in a fraction of a second, the current will practically have ceased flowing, and the condenser will be charged. This condition will exist as long as the condenser is connected to the battery, or other electrical source. The condenser acts as if it had

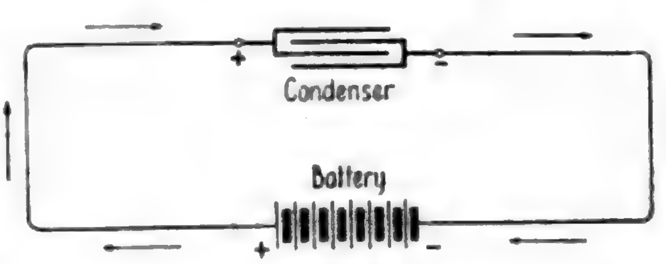


Fig. 2

Two conductors separated by a non-conductor within a circuit makes a condenser

acquired a counter E. M. F. as it becomes charged, thus bringing into play a tendency to retard the flow of current. This counter effect increases as the condenser is charged, until it becomes equal and opposite to the E. M. F. of the battery. If the battery be disconnected and

the terminals of the condenser connected together, as in Fig. 3, the charge will flow out and will result in a current of short duration. This current is at its maximum when the terminals are first connected, but it soon dies down to zero value.

When a condenser is charged, the potential difference at the terminals does not instantly come to a maximum value; in other words, a certain time elapses before the condenser reaches full charge. This apparent absorption is due to an action on the dielectric surface. At discharge, a certain time also passes before the previous charge is entirely removed; some of the charge has been absorbed into the dielectric, which charge is called residual. A condenser exhibiting this quality possesses residual absorption. Hence, the actual capacity of a given condenser is not definite, depending as it does upon the

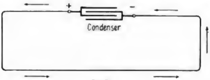


Fig. 3

With the battery removed and the circuit made complete the charge soon flows out

amount of residual absorption and leakage.

Condensers may be connected in parallel, as in Fig. 4, or in series, as shown in Fig. 5. The combined capacity of two condensers in parallel is equal to their sum. If C_1 and C_2 are the capacities of the two condensers illustrated diagrammatically in Fig. 4, their combined capacity will equal $C_1 + C_2$. This is true for any number of condensers connected in parallel; hence, if a number of condensers are connected in parallel, their combined capacity is equal to the sum of all the capacities.

The combined capacity of two condensers in series is equal to unity divided by the sum of the reciprocals of the two capacities; or, referring to Fig. 5:

$$C = \frac{1}{\dfrac{1}{C_1} + \dfrac{1}{C_2}} = \frac{C_1 \quad C_2}{C_1 + C_2}$$

This rule applies to any number of condensers in series.

Condensers are made by taking a large number of tinfoil sheets and separating them by alternate sheets of paraffined paper, mica, or other insulating material. The whole mass is pressed tightly to-

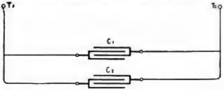


Fig. 4

With condensers connected in parallel their combined capacity is equal to their sum

gether, one set of sheets being connected with one terminal and the alternate set with the other, as illustrated in Fig. 6. It should especially be noted that no electrical connection exists between the sets of plates connected to the two terminals, since it is this property of inductivity of the dielectric that enables the condenser to store up such an enormous charge of electrical energy.

The quantity of electricity held by the condenser may be made greater by increasing the charging *E. M. F.* and is directly proportional to this *E. M. F.* In addition, it is found that for a given voltage, the quantity of electricity which the plates will acquire depends upon their size, their separation, and the dielectric or insulation between them. The quantity of electricity held by either plate of a charged condenser, represented by Q, may be written equal to the product EC,

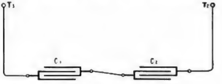


Fig. 5

Also if the condensers are connected in series their combined value equals their sum

where E is the charging *E. M. F.* and C is a constant factor which takes into account the construction of the condenser. This factor C is known as the capacity of the condenser.

Thus, we may write, $C = Q/E$, or the capacity of a condenser is the quantity of

electricity it has on either plate, divided by the potential difference between the plates. A condenser would, therefore, have a capacity of unity in the practical system of units if it would hold a quantity of one coulomb, (the quantity of electricity transferred when a current of one ampere flows steadily for one second), at a difference of potential of one volt. Such a capacity is called a farad. This unit represents, however, an enormous capacity as compared to those met with in practice, so that it is usual to express capacities in microfarads, (m.f.). Thus, one m.f. = 0.000001 farad = farad $\div$ 10^6 = farad x 10^{-6}. But, whenever the general equation is used, the capacity must always be reduced to farads.

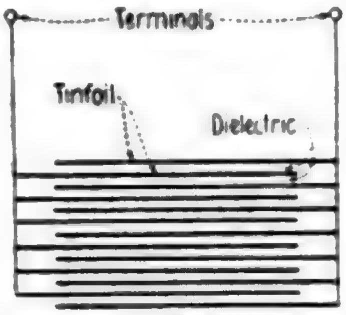
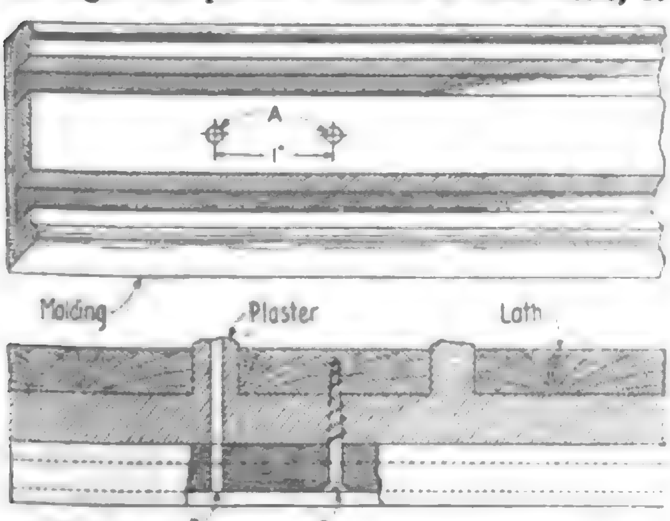


Fig 6

A number of plates made up into sets

Securing Wood or Metal Molding to Plaster Walls

THE electrician will find, when putting up wood or metal molding, that by drilling two holes, *A*, 1 in. apart, instead of one hole, every 3 ft., that not only will time be saved but the molding will be more secure. The reason for this is that if the hole *B* was used and the screw went through the plaster between the laths, it



Two holes drilled close together into the molding hastens the work in putting it up

would be a simple matter to put a screw in hole *C* and to strike a lathe into which the screw could easily be fastened.

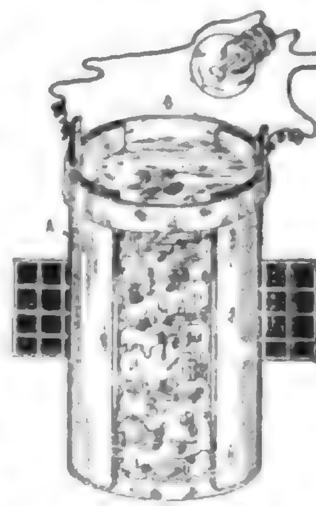
Now We Reach the Philippines Directly by Wireless

THE last link in a long chain of wireless stations, reaching from Arlington, near Washington, to the Philippine Islands, was recently forged. Cavite, this latest station, situated near Manila, has been building for some time. At its opening Admiral Knight, commander of the Asiatic fleet, sent a message of greeting to Secretary Daniels. In his reply the Secretary commented upon the ease with which our warships in Asiatic waters can now be reached. The chain of stations consists of Arlington, Darien, San Diego, Pearl Harbor, and Cavite.

A Small Storage Battery Made With a Sponge

A STORAGE battery can be made from two lead plates and an old sponge, that will give good service for lighting a small lamp or running small motors.

The battery is made with a one-pint glass fruit jar. *A*, two lead plates *B*, 1/8 in. in diameter and as long as the jar, are bent to set opposite each other, each covering one-fourth the inside circumference of jar. A large coarse sponge *C* is obtained which must be thoroughly cleaned and dried. Then obtain a piece of lead, and with a coarse file cut off enough filings to fill every pore in the sponge. When this is done, sprinkle the filings on the sponge which is in the jar between the plates. Be careful to keep the filings from falling out of the pores. The sponge must fit tightly against the walls of the jar to hold the filings in. Next fill the jar with one part sulphuric acid to seven parts of distilled water.



A 16 c. p. lamp must be used while charging

If this battery is charged in series with a 16 C. P. lamp on 110 volt D. C. line it will give 2 volts and 14 ampere hours.—WILLIAM HARRIER.

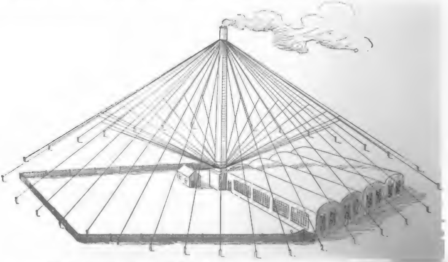
How the Zeppelin Raiders Are Guided by Radio Signals

An ingenious system not unlike that of the flashing light which guides mariners along the rocky coasts

A ZEPPELIN which is sent from Germany to England on a bomb-dropping expedition must travel by the shortest route. Only a limited amount of fuel is carried in order that the load of bombs may be as great as possible. But how does the captain of the ship determine that route? In time of war cities are darkened and all guiding lights are extinguished. The stars may help him. The trouble is that he travels so fast that he would have to read them at least ten times as often as would be necessary on board a ship at sea. Again, the sky may be overcast with no stars visible at all, although a war Zeppelin capable of flying four miles high could escape by rising above the clouds.

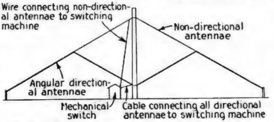
This is very plausible to the lay mind, but perhaps too far from the real facts. Actually the darkening of cities has never prevented finding the route. Rather invisibility of the ground due to "thick" air or actual fog, has. Even then a fairly true course might be steered by "dead reckoning"; i. e., by computing distance and direction from log and compass, and then tracing the results on the map. But the unknown and variable wind-drift prevents this. Measuring the earth's magnetism would prevent getting far astray, but the needed apparatus would be heavy, measurements must be very numerous, and each measurement means extremely difficult and accurate work.

Radio communication was soon found to offer by far the most convenient solution of the problem. The L-49, which recently fell into the hands of the French absolutely intact, had a marvelously complete radio equipment. Even before the war, a passenger Zeppelin, the *Viktoria-Luise*, kept in continuous communication with the Island of Nordeney in the North Sea while scouting near Strassburg on the upper Rhine. That was in 1912. Since then the range of a Zeppelin's radio apparatus has been trebled.



A Telefunken-compass sending station. Factory chimneys frequently serve as aerial supports, as in this case. Germany thus effects a saving of metals valuable for other war needs

On page 451 and following of the March 1916 number, POPULAR SCIENCE took up and discussed at considerable length two radio directional systems, the Bellini-Tosi and the Telefunken, by which ships at sea could find their way along coasts and into harbors in spite of fog or blinding storms. It is this apparatus which has evidently been adapted extensively to war Zeppelins.



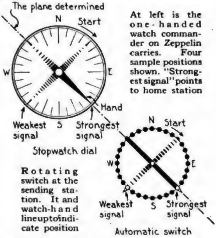
Section of Telefunken-compass sending station. Sixteen such sets form the aerial shown on page 632

In wireless, parallel antennae give the strongest signals; those at right angles, the weakest. It is this principle which makes all radio direction-finding possible.

In the Bellini-Tosi system the moving station sends signals to a fixed station, and the fixed station, by special apparatus, determines the direction of the sender and thereupon transmits the information to the sender by radio. Under the Telefunken plan, the moving station determines its own position, powerful signals having been sent out from fixed stations along shore. This seems to be the better arrangement, as it is more practicable to have powerful stations on shore than aboard an airship. The signals can radiate out over longer distances, the sending station can be entirely automatic, and on board the airship the commander need only listen for loudest signals (or weakest, whichever he prefers), hold a one-handed stop-watch—hereafter described—in his hand, and he gets his direction almost at once. No doubt the many war Zeppelins which have ventured out over England have used this system. Details of the whole plan are interesting.

The powerful sending stations in Germany have thirty-two very long, slanting antennae radiating from a tall central mast. These antennae are the exact equivalents of the rays to be found on every ship's compass, and, like them, represent the thirty-two fixed points of the compass. A mechanically operated switch connects with opposite pairs of these separate aerials once every thirty seconds. A single telegraphic dot is flashed out at each connection. In this way all points of the compass are reached every half-minute.

Any German aircraft, whether it is a Zeppelin or a small reconnaissance biplane, is able to pick up these dots, and by this means it can determine its direction relative to the sending station. No other addition to its regular receiving apparatus is required. However a calibrated pocket stop watch must be referred to. By "calibrated" we mean that the hand of the watch runs like the previously described switch, and that it makes a complete revolution around the dial in thirty seconds. The dial is, of course, marked like that of a navigator's compass with the usual thirty-two points instead of with ordinary minutes and seconds.



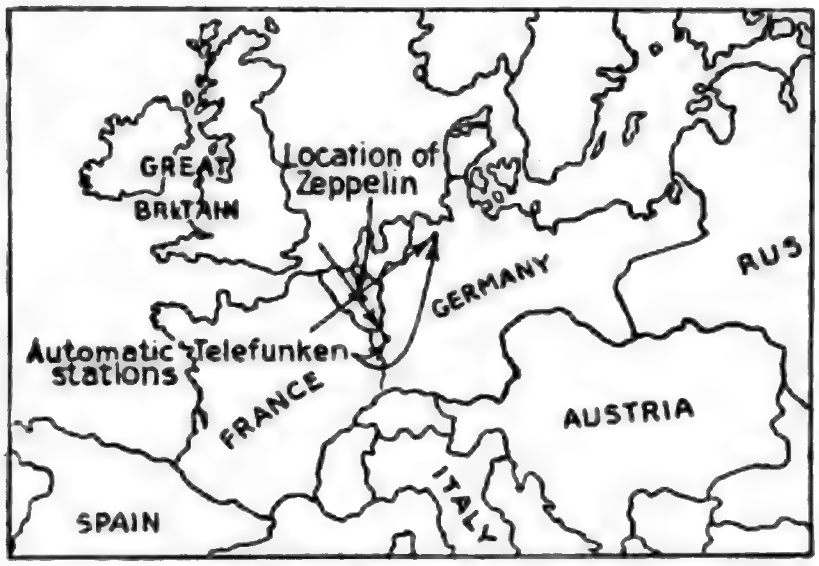
At left is the one-handed watch commander on Zeppelin carries. Four sample positions shown. "Strongest signal" points to home station

Rotating switch at the sending station. It and watch-hand line up to indicate position

Since commander's watch-hand and the sending switch rotate in unison, loudest signal determines plane in which sender is located

Apparently the Zeppelins using the Telefunken-compass are equipped with ordinary non-directional aerials for receiving the signals.

In actual operation the sending station mechanically rotates its switch and sends its dots as continuously as a lighthouse with a rotating lantern flashes out beams of light. But there is a short stop before each new rotation, which commences with the first dot flashed by the north-pointing antenna. During this short stop another but different signal is sent—a non-directional signal which is flashed over all the antennae and which is heard clearly and loudly in any direction. This signal identifies a station by giving its name or its number and supplies the information that in another moment another cycle of dots will be sent out toward east, south, and west, commencing at the north. The aircraft commander thereupon sets the hand of his stop watch to the north. He may press the starting button as soon as he hears the first dot, and the stopping button as soon as he hears the weakest dot, or he may press the button at the strongest dot. In actual practice, he pushes the button at the dot immediately following the weakest (or strongest) signal. The difference in loudness is considerable from dot to dot. Indeed, the loudness progresses or decreases around the circle of the compass, depending upon the direction in which one reads.



Intersecting lines from sending stations tell a Zeppelin commander his position accurately

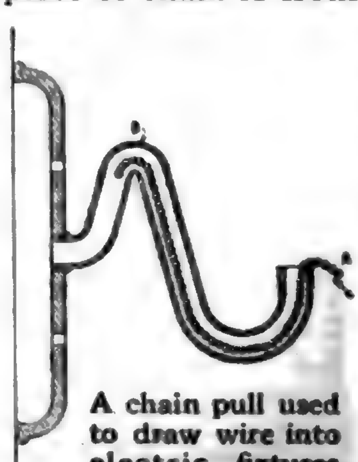
Imagine what a sensation it must be to be up in a Zeppelin high over an impenetrable cloud bank, the sky overhead obscured by the bulk of the gas bag, and for these reasons all the landmarks by which a man ordinarily locates himself obscured. Yet from somewhere beyond the clouds beneath comes that clear radio call indicating that in this direction at least lies a home station. The beacon is welcome. All the Zeppelin commander needs to do now is to tune a bit differently and go through the same performance with another automatic station. In a minute or two he has read on his stop watch dial his direction relative to two different stations whose identity he knows. Drawing lines in these two directions from the locations of these stations on his map, he sees his own location plainly marked on the same map at the point where both lines intersect. More he could hardly demand. But he may repeat the procedure many times in order to check up his location as frequently as the rapid progress of his craft demands.

In peace time the range was intentionally cut down to fifty miles in order to prevent interference with regular wireless traffic. But in war, especially during a raid, a vastly greater amount of current may pass through the switches and the antennae may be worked to full capacity.

Although the Zeppelin's long range Telefunken compass uses the same theoretical principles as the Bellini-Tosi method; that is, that parallel aerials result in loudest signals, the Bellini-Tosi method is apparently ill-adapted to Zeppelins. The Telefunken plan seems probably the one universally used.

Fishing Electric Wires Through Tubes in Fixtures

WHEN fishing wires through a fixture, which has a sharp angle, a piece of chain *A* from a pull chain socket can be used to good advantage. If a wire is used it may get caught at point *B*, while the flexible chain readily passes around this bend. A strong cord can then be attached to the wire which is easily drawn through the fixture.



A chain pull used to draw wire into electric fixtures

Wireless Work in Wartime

IX.—The Primary Oscillation Circuits of the Spark-gap Transmitter

By John V. L. Hogan

THE March article of this series discussed the power-supply circuits of the spark-type radio transmitter, showing how alternating current energy was supplied to the power transformer and converted to a *higher* voltage suitable for charging the primary condenser. The illustration Fig. 34 is reproduced this month so that the details of this assembly

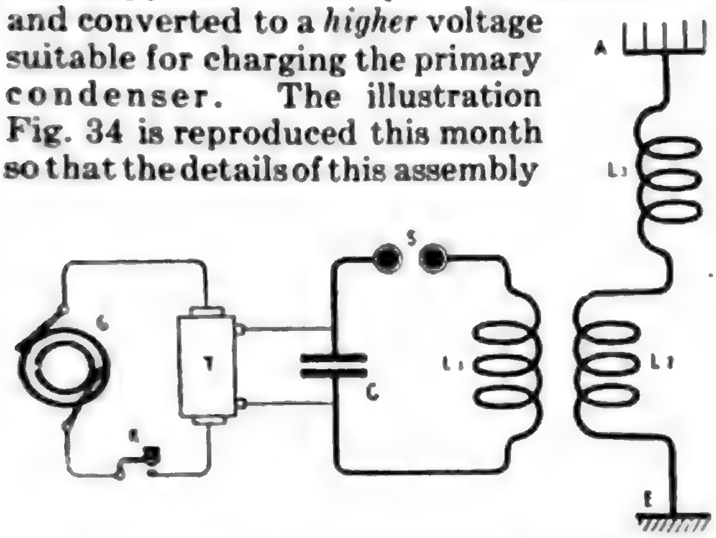


Fig. 32: The coupled two-circuit transmitter overcomes difficulties from the plain antenna

of apparatus may be held clearly in mind, and Fig. 32 is also shown again since it gives the normal connections from the primary condenser *C* to the spark-gap *S* and the several tuning coils. This instalment will take up the behavior of the spark-gap and the primary oscillation circuit, which is composed of the gap *G*, the condenser *C* and the primary L_1 of the oscillation transformer or inductive coupler.

In the first place, it must be understood that the transmitter really has two primary circuits and two secondary circuits, just as it has two transformers. With reference to the low or audio frequency power-supply, (which is usually of from 60 to 500 cycles per second frequency), the primary circuit comprises the generator armature, the key and the primary of the power transformer. The audio frequency secondary circuit involves the power transformer secondary *S*, and the condenser, *C*. In regard to the radio frequency oscillations which are produced by the condenser (and which in turn produce the wireless waves), the other primary circuit consists of the condenser *C*, the spark-gap *G*, and the primary coil L_1 of the oscillation transformer or inductive coupler. The radio frequency secondary is formed of the antenna *A*, the antenna loading coil L_3, the secondary L_2, of the inductive coupler, and the ground connection *E*.

The Voltage Applied to the Condenser

Considering Fig. 34 for a moment, it should be evident that if an alternating current of 500 cycles (complete reversals) per second is developed by the generator, corresponding voltages will be applied to the plates of the condenser *C*. At intervals of 1/1000 second this condenser will be charged in alternate directions, first with the upper plate positive and the lower negative, then with the upper plate negative and the lower positive. If the wires *X* and *Y* are left open or disconnected, the condenser charges will merely flow back through the secondary winding *S* as the potential changes at each half cycle. The illustration Fig. 35 should make this action even more clear, since it shows the potential of the upper plate of the con-

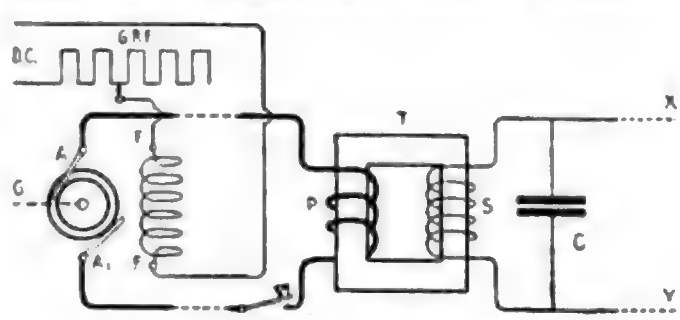


Fig. 34: In addition to the generator itself the circuits of the transmitter are shown

denser (with respect to the lower plate) at the various instants in a full cycle of 1/500 second. The wavy line represents the passage of time by its progress toward the right (thousandths of one second are marked off along the horizontal line or axis of time) and the potential of the condenser by its vertical height

at any point corresponding to any particular instant. The vertical or voltage axis on the left is marked off to show positive voltages above the central or zero point, and negative voltages below. If we follow along the curve we find that at the beginning, at 1/1000 of a second, at

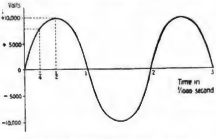


Fig. 35: Graphical representage of the five hundred cycle secondary voltage

2/1000 second, at 3/1000 second (and consequently at each one-thousandth second or at the end of each half cycle) the voltage of the condenser is zero. This is shown by the fact that the wavy line crosses the zero line at the point corresponding to each of these instants, and means that for the moment the condenser has no charge. If we look for the points of maximum voltage, we find that at half a thousandth of one second the condenser is charged to 10,000 volts positive, at one and one-half thousandths to 10,000 volts negative, at two and one-half thousandths to 10,000 volts positive again and so on continuously. In the same way we find that, starting from zero time and zero voltage (at the extreme left of the diagram) the voltage gradually rises in the positive direction, reaching about 7000 volts in one quarter of a thousandth of one second, passing through the high point just mentioned, and then falls to zero and begins a similar operation in the reversed direction.

The Charge in the Condenser

The condition just examined is based upon the assumption that nothing is connected to the wires X and Y. When the condenser is charged either positively or negatively, a certain definite amount of electrical energy is stored in it for the time being. This energy may be allowed to flow back into the secondary coil S, as has just been shown, or it may be withdrawn from the condenser for some more useful purpose. The amount of electrical energy thus stored may have large values for a time; the quantity depends entirely upon the capacity of the condenser (its storing ability) and the voltage to which it is charged. Obviously, to take the energy out usefully one must have some method of catching the condenser when it is charged; to get the most energy from each half cycle, the charge must be withdrawn at the instant of maximum voltage. This requires some automatic device which works regularly and quickly, since the highest voltage occurs only each one-thousandth of a second and lasts for only a few ten-thousandths of one second.

How the Condenser Discharges Through the Spark-Gap

Let us suppose that the condenser is shunted by the circuit of Fig. 32, which shows the spark-gap S connected across it through the primary L_1. If the spark-gap consists of two electrodes which are separated widely, there will be no new effect; if, on the other hand, the spark-gap points are brought within about ½ in. of each other, the potential of 10,000 volts will be sufficient to break across the air space. This will cause an entirely new and useful sequence of events, as may be seen from the following: If the gap electrodes are separated to exactly the distance which permits a spark to pass when a voltage of 9,500 is applied across them, it is evident that it will not be possible to charge the condenser to 10,000 volts pressure. This is because when the voltage has risen to the breakdown point of 9,500 volts, the energy in the condenser will discharge across the gap in the form of an electric spark. The illustration Fig. 36 will serve to give a rough idea of how the condenser potential is affected; following the voltage line from zero at the left, it is seen that when the potential of 9,500 is reached there is a sudden drop through zero voltage and on farther down to about 8,000 volts negative. This happens because all the stored electrical energy rushes across the spark-gap S through the inductance (primary coil) L_1 shown in Fig. 32. The discharge does not stop at zero voltage, but continues farther in the same direction because of the magnetic effect of the primary coil

L_1; when it has built up to a fairly high voltage negatively, the current in the coil and gap circuit reverses and an inverse discharge begins in the opposite direction. This also continues beyond the zero voltage point, and results in a positive charge of the condenser. Here the condenser begins a third discharge, this time in the same direction as at first. Thus a rapidly reversing current is set up in the condenser, coil and spark-gap circuit, the successive swings of current from one side to the other becoming smaller and smaller until the energy is all used up or withdrawn, or until the spark-gap regains its normal non-conducting condition and prevents further passage of a spark.

Detailed Study of Condenser Voltage

If we examine Fig. 36 a little more closely we may see just what happens throughout a full cycle of applied alternating current (audio frequency) power. Beginning at zero, the condenser voltage builds up to about 9,500 in a little less than one-half a thousandth of one second and then, at the point *A* on the curve, the high electrical pressure makes the spark-gap conductive and the oscillatory discharge begins. This discharge consists of a number of rapid or radio frequency alternations of potential (with corresponding radio frequency alternating currents), and lasts for about one-quarter of a thousandth of one second before the energy is used up and the spark-gap again becomes non-conductive. This occurs at the point *B* of the curve. With the spark-gap open (no spark passing) the condenser begins to assume its normal voltage from the audio frequency alternating power applied to it, and rises to, say, 5,000 volts at the point *C*. This pressure is not enough to break down the spark-gap, and consequently the condenser potential follows the impressed potential of the power transformer secondary, passing through zero at *D* (the end of the first half cycle of power) and then beginning to charge negatively or in the reversed direction. At *E* the condenser potential has reached 9,500 volts negative (i.e., with the lower plate positively charged) and the spark-gap again becomes conductive and allows the discharge to pass through the primary oscillation circuit composed of the condenser, the primary coil L_1 and the spark-gap. As before, radio frequency oscillations continue for about quarter of a thousandth of a second (to the point on the curve marked *G*) and then the gap becomes

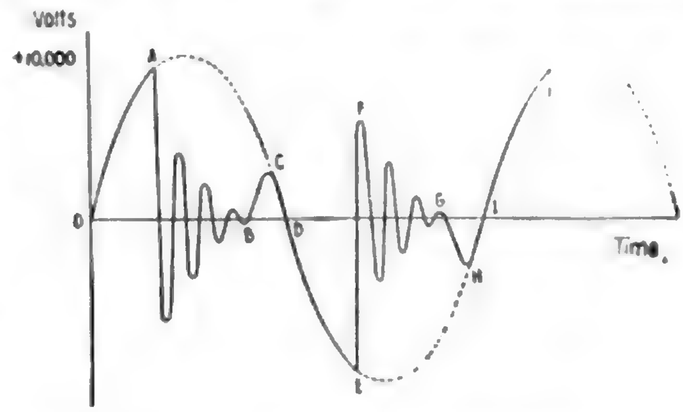


Fig. 36: How the radio frequency oscillations are produced by secondary discharge

non-conductive. The normal charging of the condenser follows through the high point *H* and the zero point *I*, at the end of the second half cycle or the first complete cycle of applied power. Thereafter the same series of operations is repeated, and sparks representing a group of dwindling radio frequency oscillations pass in the middle of each half cycle. Thus, if the applied power has a frequency of 500 cycles per second there will normally be produced 1,000 sparks or groups of oscillations per second.

Mechanical System for the Conversion of Frequency

We have evidently been considering an arrangement of apparatus which will convert, by way of the condenser discharge, audio frequency alternating current power into the radio frequency oscillations which are necessary for wireless signaling. The action may perhaps be more vividly appreciated if we consider a similar mechanical system for increasing frequency. Let us imagine a stiff spiral spring *S* having a weight *W* hanging upon it, and supported from a heavy beam *B* as shown in Fig. 37. If a thin thread *I* is tied to a hook set in the bottom of the weight, we may slowly pull down on the spring and weight system until the tension on the spring is great enough to break the thread. Then the weight will bob upward rapidly, and its inertia will carry it

somewhat beyond the point of rest and compress the spring. Thereafter the weight will immediately start downward; and it will continue to oscillate up and down in shorter and shorter strokes until the energy stored in the weight and spring system has been used up. This corresponds in many ways to the circuit

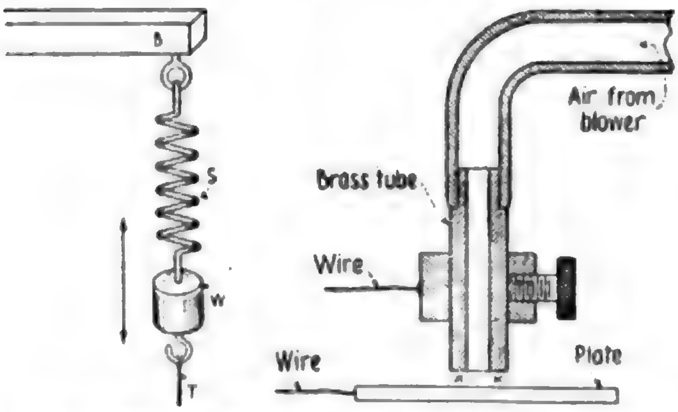


Fig. 37: Mechanical oscillating system
Fig. 38: Practical air-blast spark-gap

shown; pulling against the spring until the thread breaks is comparable to charging the condenser until the spark-gap breaks down, and the rapid up-and-down oscillations of the weight and spring are much like the rapid electrical oscillations in the condenser and coil circuit. The spring is analogous to the condenser C and the weight to the inductance coil L_1; it is the stress of the spring (and in the condenser) which trips off or breaks down the restraining element (thread or spark-gap), and it is the energy stored in the weight (and in the inductance coil) which carries the oscillations beyond dead center on each swing and so keeps the system vibrating.

Controlling the Oscillation Frequency

The two systems are alike as to another important point, viz., the frequency of the oscillations. We know from experience that the greater the mass of the suspended weight and the greater the flimsiness of the spring, the more slowly the mechanical vibrations of the system. By varying either or both of these we can make the weight bob up and down at almost any frequency we choose. In the same way, the frequency of electrical oscillations in the condenser and coil circuit is almost entirely dependent upon the size of the condenser and coil. The larger the condenser (the greater its capacity) and the larger the coil (the greater its inductance), the slower the radio frequency oscillations will be. Thus, by altering the electrical constants of the circuit (e.g., the capacity and inductance), we can make the oscillation frequency almost anything we desire. This matter will be treated in greater detail later.

The next point which should be considered here is the construction of a spark-gap which will work regularly and continuously. Commercial radio practice has brought out a great many types of spark-gap, but years of experience have shown that certain properties must be secured if satisfactory operation is to be expected. In the first place, the gap must always break down at some definite voltage. It is evident from Fig. 36 that if the potential which established conductivity across the gap varied, the oscillations would begin at different points in each half-cycle and that the oscillation groups would not occur regularly. If the break-down potential were normally 9,500 but sometimes became 8,000, when the lower value held the oscillations would start off too soon in the half-cycle, and the full discharge of the condenser would not be utilized. If it ran up to 11,000 volts, no spark would pass at all, and the charge for that particular half-cycle would be practically wasted in so far as the production of a group of radio frequency oscillations was concerned. Uniformity of sparking potential depends upon keeping the gap cool more than on anything else, since the hotter the gap the lower the potential at which it breaks down. For small powers the necessary cooling may be secured by making the spark-gap terminals large, since then the heat will be carried away rapidly by the mass of metal. For larger powers some form of artificial cooling is used.

A Successful Cooled Spark-Gap

A form of air-cooled gap which has been found satisfactory for many purposes, is shown in Fig. 38, and which is largely used by the French. It consists merely of a brass or copper tube forming one electrode and placed endwise to a flat plate which acts as the other terminal. A blast of air is fed through the tube by way of a rubber hose, and spreads out

over the surface of the plate. The spark passes between the rounded end of the brass tube and the flat surface, and hot conducting gases formed by the discharge are blown away by the current of air. By using large masses of metal and a strong blower, fairly heavy oscillating currents may be passed across the gap without overheating—especially if a low group frequency is used so that the gap may cool off somewhat between successive sparks. A gap of this sort was used in the Eiffel Tower station which sent signals across the Atlantic to Arlington, Virginia, in the international longitude experiments of some years ago. It is even more successful with smaller powers, and represents, perhaps, the best practice in the so-called stationary open spark-gaps.

In the next article, the construction and action of the rotary and modern "quenched" gaps will be described, and thereafter the interactions of the two oscillating circuits and the production of radio waves will be discussed.

(*To be continued*)

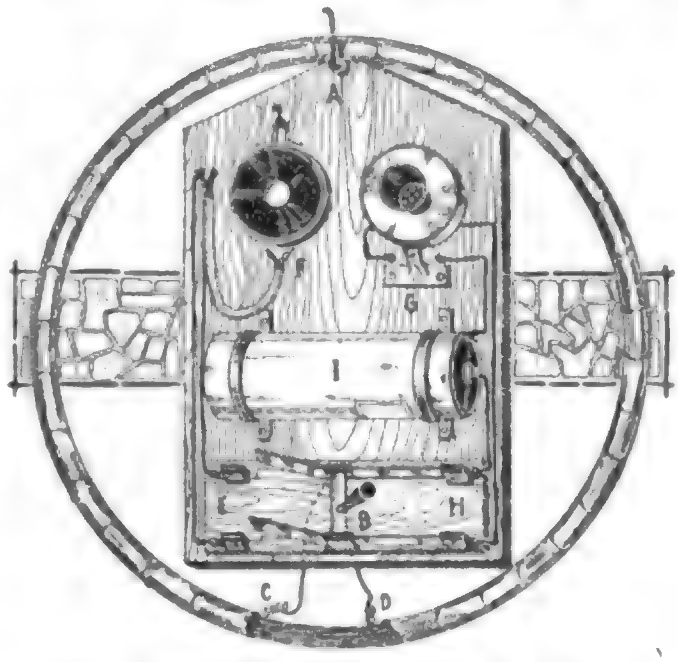
A Simple Compact Short Distance Wireless Telephone

VARIOUS methods have been devised by which one can talk without wires to a person over four thousand miles, but it is not generally known that in 1882 Prof. Alexander Graham Bell constructed an apparatus with which he was able to transmit the voice several miles without metallic conductors. The principle involved was that of magnetic induction, which, simply explained, is a field of force induced by passing an electric current through a coil of wire. This so-called "field of force" is again detected by a similar coil placed in a direct line with the source. The limited distance that the voice could be transmitted, due to mechanical difficulties, prohibited such an apparatus from being of commercial value, but for experimental purposes, or for communicating short distances, such as between rooms or nearby buildings, it is practical and it is something unusual for the amateur to build.

The accompanying drawings illustrate a compact outfit suitable for talking to some one 50 to 100 ft. away.

A base-board *A*, somewhat like the one shown, should be screwed to the wall at a convenient height for talking. A common coat-hook is fastened to the peak.

Then make a large coil of insulated bell-wire (about 3 or 4 ft. in diameter) using about 350 ft. of wire. Number 20 gage is a good size for all practical purposes, but the finer the wire and the



One of the two apparatus used for sending messages by home-made wireless telephone

greater number of turns with a corresponding increase in the diameter of the coil, the greater is the distance one can talk. Leave 1 ft. or more of the ends of wire projecting and wrap the entire coil securely with tire-tape. The coil is then ready to hang over the hook on *A* and should be large enough to hang clear of the bottom edge of *A*.

A two-way knife switch *B* of the style shown, is attached to the base of *A* and the center terminals are connected to the ends of the coil *C* and *D*. One side of the switch *E* is then connected to a pony telephone receiver *F*, which can be hung from a convenient hook near a telephone transmitter *G*. This transmitter is connected to the opposite poles of the switch *H* as shown; a dry-cell *I* cutting in one line. The battery is fastened to *A* by means of a pair of metal straps.

A duplicate apparatus should be placed at the other end of the "line," in a position as nearly parallel as possible, to receive the full benefit of the "field of

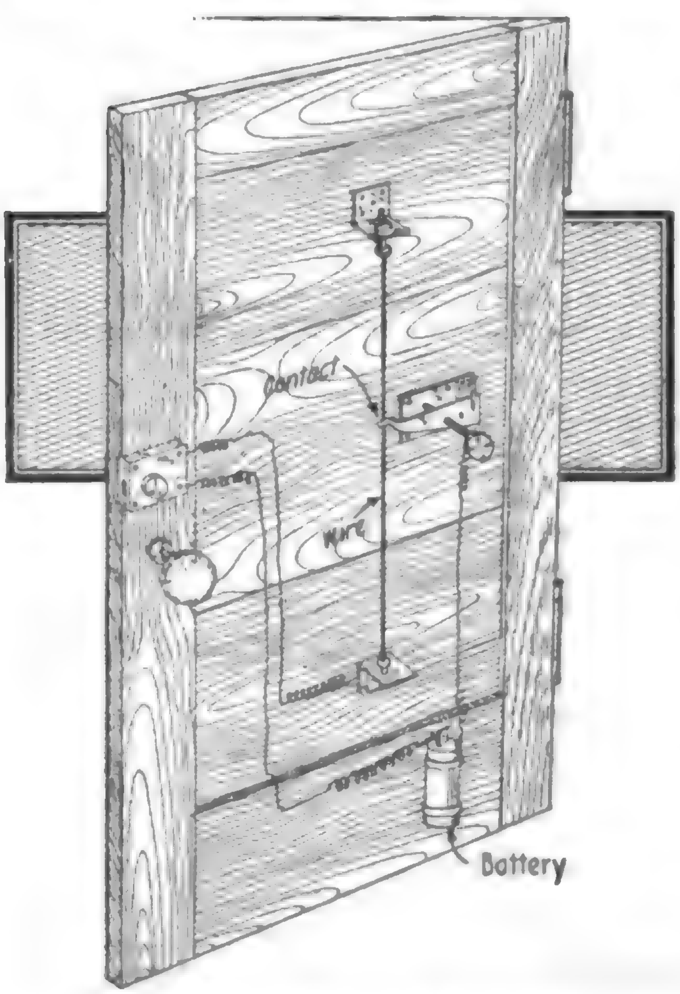
force." When one desires to talk vertically; that is, from one floor of a house to another; lay the coils flat on a table and in line with each other.

To converse; throw the switch to *H* and call the other party by tapping on the transmitter diaphragm. Immediately upon speaking, throw the switch to *E* to receive the reply. The other party duplicates these motions. When through speaking, leave the switch at *E*.

Larger coils may require an additional cell to assist in lengthening the speaking distance.

A Keyless Electric Lock for Use on a Panel Door

I HAVE attached a secret lock to the door of my room which does not require any key to open it. The lock itself



This obedient electric lock opens the door when you knock in the right place

is an ordinary electric lock, but it is the way that the contact is made through it in opening the door that makes my scheme different from others. A vertical wire is suspended the full length of the panel on the inside of the door. Directly opposite the middle of the wire and quite close to it, a small brass plate is mounted. One end of the battery-and-lock circuit is connected with the vertical wire and the other end with the brass plate. Whenever I desire to enter my room, I simply knock on the outside of the panel; the wire vibrates, it finally touches the plate, the circuit is closed, and the lock opens.—THOMAS W. BENSON.

A Simple Method of Silvering Brass and Copper Articles

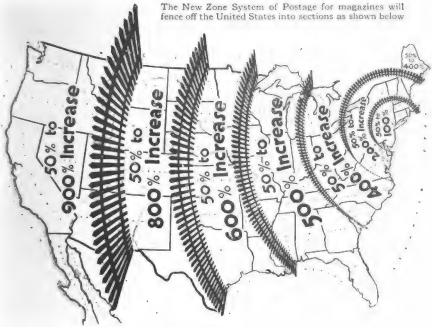
IF you desire to coat the surface of brass or copper articles, the following method is very simple and the results are exceedingly satisfactory.

Procure some scrap silver from a local jeweler and dissolve it in strong nitric acid, diluted with about half its bulk of water. Be sure always to pour the acid slowly into the water and not vice-versa, or it will fly up into your face. Stir the mixture with a glass rod while mixing it. When mixed pour it into a glass bottle or a porcelain saucer. If the acid is slow in attacking the silver, warm it gradually. Dense fumes are given off, so this work should be done on a grate fire where the fumes can pass up the chimney, or on an oil stove outdoors. Use a great deal of care in handling the acid and do not inhale the fumes from the chemical action.

When the silver is dissolved, dilute the solution with a quart of water and pour a strong solution of common salt and water gradually into the nitrate of silver solution. A dense precipitate of chloride of silver results. Collect the chloride of silver on filter paper by filtering it, wash it several times and dry it. Then mix the substance with three times its own bulk of table salt and twice its own bulk of cream of tartar; taking care to mix the ingredients thoroughly. It is then ready for use. This is rubbed on the brass or copper article with a wet cotton rag. After the silvering is complete, wash the article with hot water, and varnish it to prevent tarnishing. The unused silvering solution should be put into a bottle and the bottle set in a cardboard box and kept in a dark place to prevent it turning black.

Do You Want to Split Up the United States?

The New Zone System of Postage for magazines will fence off the United States into sections as shown below



NO, of course you don't. But you are helping to do it right now by not writing a letter of protest to your Congressman and your Senators about the Zone System for magazine postage recently passed by Congress.

How quickly would the States be broken up into separate countries if we had to pay import taxes on all goods shipped between states? Well, it wouldn't take very long.

But Congress has passed a law by which it will cost more to get your magazines delivered the farther you live from where they are published. The farther west you live the more you will pay for magazines published in New York, Philadelphia or Boston.

Canada, at war for three and a half years, still sends two pounds of reading matter for one cent to the farthest points of the Dominion. Our Government proposes to charge ten cents a pound for carrying to the Western States the advertising portion of POPULAR SCIENCE MONTHLY and other publications—*just twenty times Canada's rate!* We should be able to deliver as cheaply as Canada can.

When the new Zone System is finally in full force, the cost of magazines in the Middle and Far West will be so great that thousands of people will be obliged to give up their magazines and other periodicals. They no longer will keep up with the intellectual life of the country. The West will no longer be united in the old compact way with the East.

The new Zone Law has not yet been put into effect. You can help to get it repealed. Write your Congressman and your Senators and protest. If you do not know their names, ask POPULAR SCIENCE MONTHLY or your Postmaster, but whatever you do *protest.*

S[illegible]ngs

This is [illegible] is true, but comple[illegible] carried aloft by the [illegible] ammunition to th[illegible] handful of men

Popular Science Monthly

225 West Thirty-ninth Street, New York City

Vol. 92
No. 5

May, 1918

$1.50
Annually

Using a Ford as an Airplane-Tender

It could be done if the tender were designed to offer the least possible resistance to the air

By Carl Dienstbach

FROM afar comes the rolling thunder of the field guns, heavy blasts marking the rhythm of the heavy artillery. The sharp staccato of the machine guns and the spiteful cracking of the rifles cannot be heard so far behind the battle line. Undisturbed by the distant din and turmoil the birds are singing, feeding and making love as if there were no such things as bloody war and destruction.

Suddenly their singing, twittering and chirping cease. Their sharp ear has heard a strange sound to which it has not yet become accustomed as it has to the distant din of battle. It is a whirring sound, at first faint, yet sharp and persistent. As it approaches it becomes louder and more terrifying. The birds flutter around and seek shelter.

A few moments later an airplane of a strange type appears above the treetops, makes a sharp curve and, with a graceful glide, comes to rest upon the clearing which crowns the top of the hill. It is a huge monster. Wings of great expanse and a tail in proportion rest upon a strange big body, streamlined and provided with wheels. The pilot and his machinist descend and from somewhere four other men, wearing soldiers' uniforms swarm out of the body of the big monster. There is some hurried activity and after a few minutes the big body is detached from the airplane, which then, greatly lightened, is ready for its return journey. The pilot and the machinist clamber to their respective places, a hearty "Good luck!" a wave of the hand, and, with a short run the machine rises from the ground and quickly disappears behind the treetops flying in the direction from which it had come a short time before.

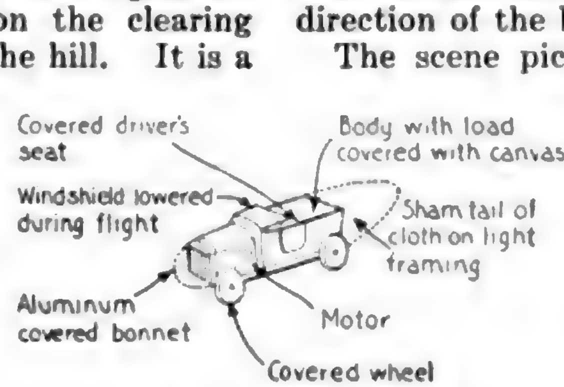


Diagram showing method of streamlining a Ford for easy transportation

The body of the monster, relieved by the busy hands of the soldiers of its streamlining shell of canvas and aluminum, proves to be a Ford, carrying two machine guns and a load of ammunition and provisions, in addition to the gasoline required for a long trip. The shell is folded up and loaded on the car by three of the men, while the fourth is busy around the engine, putting it in shape for an immediate start. Five minutes later the Ford is mounted by the four soldiers and chug-chugs away in the direction of the battlefront.

The scene pictured in the preceding lines is merely imaginary, but it may become actual, if the suggestion of L. R. Carroll, of Roundup, Montana, is adopted and carried through by the government.

The giant flyers of today have ample lifting power to carry a Ford together with its cargo. Aerial transportation does not balk at the weight to be carried, but at the indifferently

shaped bulk of the load. A narrow motorcycle may be lashed to an airplane, as it is, but any ordinary automobile would kill the plane's supporting power by the inordinate head-resistance it offers to the air. Racing automobiles have recently been designed with great care, so as to reduce the resistance they offer to the air, a policy which, in racing, is as vital as in flying. A racing car may be lashed to an airplane as readily as a motorcycle.

But a Ford car is not built on racer lines. The Ford would first have to be thoroughly streamlined and its wheels would have to be changed to disks by spoke-coverings. The problem still remains of providing an extra set of wheels for the airplane on which to restart and to reland after it has dropped its load. But that does not seem impossible of solution, judging from the example of the large German seaplanes, which are transformable into land-planes. These carry a set of wheels that may be lowered at will.

The plan may be carried out with a Ford even more easily than with the seaplane, because the twin-engined planes have their landing wheels under each motor, and the Ford could be suspended between them. The wheels of the Ford could form a landing gear of its own, taking its weight in landing and starting off the structure of the plane.

The Ford would require no redesigning. Light framings with canvas or aluminum covering could transform its outline into a perfect streamline, which would be materially aided by a long empty tail. . .

Doing the Washing for Forty Thousand Soldiers

ONE of the thousand and one problems which confront the military authorities of a belligerent country is the necessity of providing ways and means for maintaining the cleanliness of the troops in camps or cantonments. The soldiers wear shirts, socks and underwear and use handkerchiefs and towels. All these articles become soiled by use and must be cleansed by washing from time to time to keep the men in good sanitary condition. At Camp Upton, Yaphank, L. I., there are, at various times, from 25,000 to 40,000 men and to take care of their laundry work is a tremendous task.

The accompanying picture shows an interior view of the army laundry at Camp Upton and gives a good idea of the enormous size of the establishment. The machinery shown in the foreground is used for the ironing and pressing of the laundried garments.

These pressing and ironing machines and many others are required to do work for the soldiers at Camp Upton, Yaphank, L. I. The laundry work for 40,000 men is a colossal undertaking

Make Soldiers' Waistcoats Out of Your Old Kid Gloves

PATRIOTIC women in America may profit by the experience of their British cousins and follow their example, by devoting their attention to the making of "glove waistcoats" instead of the sweaters which their nimble fingers have been knitting heretofore for the soldiers and sailors of our country. These vests are made of waste material, discarded kid gloves, which cost practically nothing. The lining costs only thirty-five cents. One of these vests can easily be made in a day or two, while the knitting of a sweater takes considerably more time. Another advantage of the glove vests is that they weigh but a few ounces, are less bulky than woolen sweaters, yet fully as warm and more windproof. In addition to that they do not shelter vermin as do the knitted garments. It is to be hoped that American women will see the advantages in this new patriotic work.

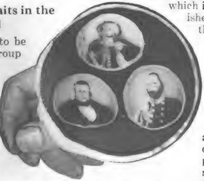
This light, warm, windproof waistcoat is made from old kid gloves at small cost

The Smallest Portraits in the World

WHAT is believed to be the smallest group of portraits in the world, is exhibited in the National Museum in Washington. The portraits are arranged in the form of a cloverleaf and are enclosed in a circular frame about one-eighth of an inch in diameter. They represent King Victor Emmanuel, Giuseppe Garibaldi and Count Cavour and are the work of Jacopo Franchini, a skillful glassworker in Murano, near Venice, Italy, who lived in the early part of the nineteenth century and worked so hard at his strange craft that he died in a madhouse.

The National Museum in Washington has recently acquired a fine collection of marvelous glass-work made by Franchini and placed it on exhibition.

The portraits are of glass and really represent a cross section of a mosaic rod of glass. Franchini's method of making these miniature portraits was highly ingenious. He began by making a mosaic of the three portraits, each in its individual frame and the whole set in a common circular frame. The mosaic was formed of sticks of solid glass of the desired color. After the mosaic was completed, the cylindrical composite rod was welded by heat and then drawn out. As the rod was drawn out it diminished in diameter and the diameter of the individual sticks of colored glass of which it was composed diminished in proportion. As the drawing out was done carefully, the particles of the sticks forming the mosaic remained in their relative positions, or nearly so. A slight distortion could not be avoided, as may be noticed in our reproduction of the portraits greatly magnified. Nevertheless, the results obtained were extraordinary.



Small object between finger and thumb and how it appears enlarged

© Int. Film Serv.
How could anyone resist the mute appeal of these canine helpers in a good cause?

Dogs as Patriotic Helpers in a Good Cause

DURING "Thrift Week" in Los Angeles these two dogs, Spike and Pride, took an active part in the campaign for selling thrift stamps. To say that they were successful only mildly expresses the result of their joint efforts. Spike and Pride made a mute but effective appeal to the patriotism of the crowds. Pride carried a basket filled with thrift stamps, while Spike, carrying a tin box with the inscription "I'm the Cashier," was soon loaded down with the weight of the coins dropped into his cashbox. The two dogs together disposed of hundreds of stamps every day and thus bravely helped the good cause.

No More Rubber Tires in Germany—Except for the Kaiser

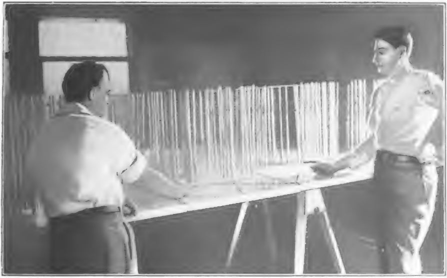
GERMANY had a little rubber in the early days of the war, but she soon became reduced to smuggling in what she could through the mails. Great Britain soon closed this channel, also the traffic in automobile tires which were being imported through Sweden. Now, only the Kaiser rides in an automobile boasting real rubber tires. Everyone else has to bump along on tires filled with cork, paper or even rags.

Locating Splinters Made Easy By This Device

TO one of the New York hospitals, located in a district where the manufacture of clothing is conducted on a large scale, so many workers came every day with splinters, parts of needles, and foreign bodies in their fingers, that it became necessary to provide some simple method of locating foreign bodies without resorting to X-Rays. The contrivance shown in the picture was the outcome of some experimenting by the house physicians. It has proved to be of great assistance in numerous instances since its adoption.

A piece of black woolen cloth, eight inches square, was fastened to a square of adhesive plaster of the same size. In the center an oval opening was made, measuring five-eighths by one-half inch. By placing this over an electric light supplied with a reflector and placing the finger of the patient over the hole, excellent transillumination could be obtained, and any foreign body in the finger easily located. This little apparatus has resulted in a saving, both in time and money, for an X-Ray machine is both awkward and rather costly to operate.

If the finger of the patient is placed over the hole a splinter can quickly be located



This forest of pegs connected by a web of strings gives us a map of geological formation of area represented. The pegs and string indicate plainly sea level and depth and oil sand slope

Making a Geological Map of Wooden Pegs and Strings

THIS map, which is made of wooden pegs and strings connecting them, is six feet and five inches wide and twenty feet and six inches long and represents the geological structure of several square miles of oil land in California.

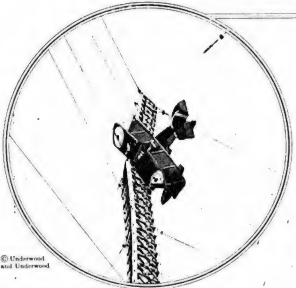
It is claimed that, by glancing at the map one can tell the depth of any well, its exact location, the thickness of the various strata found in drilling, the location of the spots where oil and water were found, etc. The pegs are painted white and have colored rings indicating the geological formations, sea level and depth. The strings connecting the pegs indicate the slope of the oil land, which is about two hundred and fifty feet deep on the west side of the fields and three thousand two hundred and fifty feet on the east side, three miles distant.

Chain Armor to Protect the Eyes from Flying Splinters

AN ingenious improvement has recently been made to the already familiar steel shrapnel helmet in use "over there." It is designed to protect the eyes and the upper part of the face from splinters of wood, stone, sand and metal, thrown up by exploding shells. The new device is merely an adaptation of the chain doors which have been introduced into metal, chemical and glass works in recent years to protect the workers from the heat of the furnaces and the splashes of molten material. It consists of a fringe of separate short lengths of fairly heavy chain, which effectively arrest the flying particles. On account of its looseness, it does not seriously interfere with the vision. Many cases of blindness among soldiers abroad are due to flying splinters.

This chain visor is designed to protect the eyes from flying splinters

As Luck Would Have It



© Underwood and Underwood

On September 14th of last year a British seaplane, emerging from a heavy mist, struck the steel-lattice mast of a wireless station on the English coast with such force that the front end of its body, with the engines became wedged in the lattice work. The pilot was stunned but did not fall and was rescued by sailors belonging to the station

When the accident occurred, several sailors were painting the lattice work of the mast. One of the men climbed out on the wedged-in seaplane and rescued the unconscious pilot, lying on top of one of the wings, 300 feet above the ground. With the help of two other sailors the airman was lowered to the ground and escaped unharmed

How Our Naval Falcons Are Unleashed

A hydroairplane at the moment of being launched from a cruiser. It rests upon a wooden car driven by compressed air power

This shows the track, fifteen feet above the deck of the ship, which serves for the launching of the hydroairplanes

At the end of the track the wooden car, which weighs about 400 pounds, drops into the water with a mighty splash, while the airplane lightly speeds on its way

Photos by Prisma, Inc.

The car is recovered by a waiting launch and towed back to the ship, to be hoisted aboard to be used again at the next start

Having completed its flight, the hydroairplane comes to rest in the lee of the ship and is once more hoisted aboard her

Boston Converts an Armory Int

Some of the sterilizers which form part of the modern equipment of the new armory hospital

Each of the twenty-two wards of the hospital contains twenty beds and has its staff of doctors and nurses in attendance

Ambulances of improved type are important auxiliaries to a hospital and many are required to deal with emergency calls

Wonderful Military Emergency Hospital

The upper picture shows how the hospital has been ingeniously built into the big cavalry armory. The lower picture shows members of the medical staff and nurses in a group

Sacred as the Apple of the Oriental's Eye

These are not just ordinary elephants. They're the sacred elephants of Candy, Ceylon, and are considered very holy. Here we see them taking their daily bath

Pigeons and cows are also considered sacred in India. Here we see both standing unmolested

Here is the sacred ox resting in a Benares street. Traffic goes around him as he must not be disturbed

Monkeys are also held in reverence. They are believed to be inhabited by souls of dead men

And We Thought We Were Cold and Starving!

Crowds surround the bulletin boards to read the announcements which are posted up concerning the sugar shortage

Firewood was so scarce, that enterprising street vendors sold it by weight to the poor at much enhanced prices

With coal at eighty dollars a ton, the poor people in Paris searched every refuse pile for bits of the precious fuel

New Ways of Using the Military Hand Litter

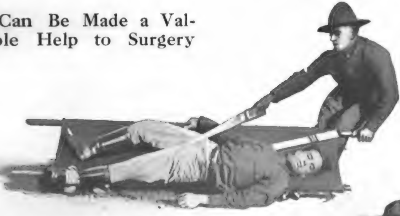
Tying the foot of the injured side with the left front litter sling. The first step toward immobilization

Major H. R. Allen, M. R. C., who has much improved the army litter

By straps and slings the patient is held immovably, even though the litter be turned over completely

This shows how complete immobilization is achieved, by means of slings, when all extremities of patient are broken

t Can Be Made a Val- able Help to Surgery



Litter with the patient on it is turned to horizontal position. Second step toward immobilization

Immobilization is maintained even though the the litter be carby the handles of one side only

The litter may even be turned on end with the patient's head down without disturbing fractures

In a case of emergency one man can carry the litter with the immobilized patient on his back without risk or danger

An Obsolete Industry Takes a New Lease of Life at Hog Island

The upper picture shows how Hog Island, near Philadelphia, is being converted into the greatest shipyard in the world. It is a miniature city in itself. It will have post-office, Y. M. C. A., theatre, etc., for the use of the employees. The second illustration shows the ribs and framework of an old-style "wooden wall" in making

Cargo-Carriers in Embryo

Here we see the framework of some of the wooden ships that are being built for the French and Italian Governments in American shipyards up and down the coast

Hull Nearing Completion

The art of building wooden ships was bidding fair to become completely forgotten. Then the war came, and wooden ships once more came into their own as transports

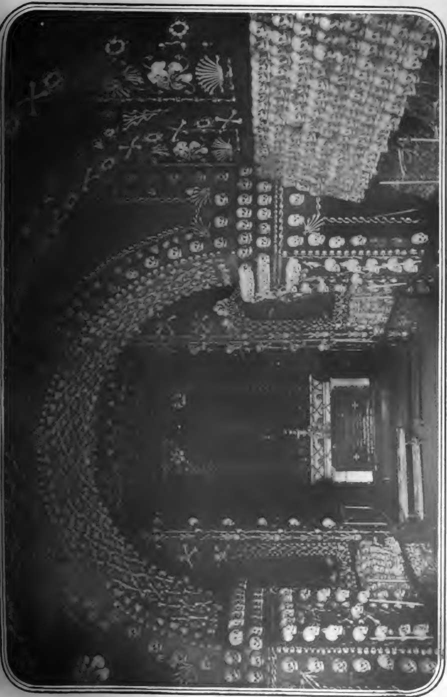
Photos © C. P. I.

These are the barracks in which the men employed in the new Hog Island shipyard will be housed. The community is complete in every way. It has a Y. M. C. A., a postoffice, etc.

Were Children and Dogs Barred There Too?

This shows a view of the court and the architecture of the oldest apartment building in the world. It was built in a village in the province of Fu-ken, Southern China, about five hundred years ago and has been in use ever since. The ring-shaped building is five stories high and contains four hundred one-family houses

All apartments open on the center court, in the middle of which is the cistern, supplying the tenants with water. There are no "modern conveniences" to speak of, but the building is well protected with a strong wall with but a single entrance. There are no windows toward the outside of the circle. A tile roof covers the structure



© Brown and Dawson

The Capuchine monks in the convent of Floriana, Malta, had a decidedly gruesome sense of beauty. Underneath their church, which was built by Grandmaster Verdala in 1584, in an arched crypt, they deposited their dead by nailing their bones upon the walls so as to form a decorative design

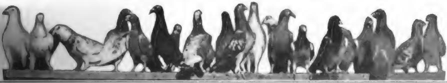
The Dove of Peace Is Resting, but

© Int. Film Serv.

Carrier pigeons offered to the government for use at the war front are first tried out. They must be wise as a judge, swift of wing and of great endurance to be useful

At the training station near Washington, D. C., not only the pigeons but also the men who handle them are trained. The soldier in the picture fastens message to pigeon's leg

The Doves of War Are Active Enough



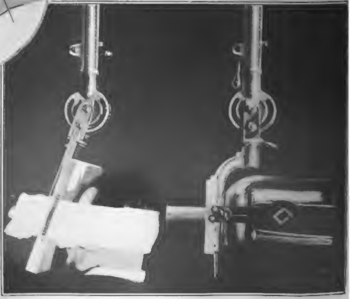
Under the control of the Intelligence Bureau of the Signal Corps thousands of carrier pigeons are trained for service at the front. The picture shows a row of cotes and above them pigeons in exercise flight

These birds are used to carry messages from the front to the headquarters behind the lines. This picture shows how the capsule containing the message is fastened on to the pigeon's leg for safe conveyance

With Drill, Telephone, and Electric Implements the

Using one of the new electric bullet detectors. A bell tinkles when the embedded bullet or splinter is encountered

Some simple instruments which are used in probing for bullets or shell splinters in the limbs or body



This shows the method of taking radiographs of the human head in the military hospitals

Modern Surgeon Salves War's Human Wrecks

Drilling through the skull is made easier and safer by the use of the precision drill. This is far ahead of the old style trephine

This electric cutter is used to great advantage in cutting plaster of paris casts when the doctor desires to remove them

The new electric bullet detector is shown here all folded up in its compact carrying case

A Boy Pathfinder Discovers a Bicycle Short Cut in an Irrigation Ditch

SCHOOLBOYS who live near El Molino, California, and attend school at San Marino, travel back and forth on bicycles through a half-mile of concrete-lined irrigation ditch. The ditch "highway" cuts off about a mile of their distance to and from school and enables them to avoid several mean hills over which no cyclists can pedal.

Robert Hutchinson, a lad of about thirteen years of age, is credited with having discovered the path. His boyish spirit of exploration led him to take his bicycle in at the upper end, and ride through the ditch. When he found that the other end emerged at the San Marino Road he realized he had made a lucky discovery. He told his schoolmates about it and since the ditch is dry about nine months out of the year, it has proved a great convenience to the pupils of the school at San Marino. This same spirit of discovery has made the world what it is to-day.

This dry ditch forms a short cut for the schoolboys of El Molino and avoids hills too

Lack of Safe Harbors on Our Pacific Coast

IN a recent publication on "The Neglected Waters of the Pacific Coast," issued by the Department of Commerce of the United States Coast and Geodetic Survey, the Superintendent, E. Lester Jones, calls public attention to the radical differences between the conditions and character of the shore line of the Atlantic and those of the Pacific coast of the United States. While the Atlantic coast and the Gulf coast have many excellent harbors scattered between Maine and Texas, the Pacific coast of the United States, which has a length of about 1,100 nautical miles, has only a few harbors which are available as a refuge for ships in stormy weather. There are no real harbors between Los Angeles and San Francisco, a distance of 367 miles and only five bar harbors, safe in bad weather, between San Francisco and the Strait of Juan de Fuca.

Trees Stunted by the Wind

TOURISTS visiting the Rocky Mountain National Park and not afraid of strenuous exercise in mountaineering, often have the opportunity of seeing tree forms like that shown in the accompanying picture. The trees near the timber line seldom grow up straight. They crawl along the ground, seeking the shelter and protection of the rocks against the violent North winds. The tree in the picture found shelter behind a big rock and grew strong and comparatively big, but the height of the rock limited the height of the tree, for it could not withstand the powerful north winds.

Only in the shelter of the big rock could the tree grow in the face of strong winds above the timber line

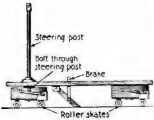
Constant Friction Made a Freak of Telegraph Key

THE peculiarly formed knob in the picture was taken from a telegrapher's key used continuously for fifteen years by Mr. W. C. Staib, operator in the general offices of the Lehigh Valley Railroad at South Bethlehem, Pa. It is true, the knob is not of stone, but of hard rubber, and was not worn by dripping water, but by the fingers of the operator, but, after all, the cause of the wear in the case of the stone as well as in that of the rubber knob is the same—friction.


This key was worn out by a telegraph operator's finger

Mr. Staib is suffering from operator's cramp and can now use but one finger in sending. In the course of time his finger, by constant friction, wore a deep indentation in the hard rubber, nearly penetrating it. The other fingers of the operator's hand, rubbing against the edge of the knob, wore away part of it, giving the knob an eccentric shape.

This is just another instance of how a constant small friction will wear out the hardest substances. Everybody knows the time-honored anecdote of the way the rims of the Eastern wells are worn out by the soft rope. There have been many instances of the remarkable effects caused by constant friction, but that of the telegraph key is unusual.



Banana Fiber Bags for Raw Sugar Containers

SUGAR planters in the Hawaiian Islands are facing a shortage of bags used as containers for raw sugar. These bags have been imported from Calcutta. Recently machinery was sent to Honolulu from the State of Washington for the purpose of manufacturing the bags from the fiber of banana tree trunks.

Making a Coaster From Roller Skates

DO boys like coasting? Just ask them, or what is even better, watch them when they have a chance to give themselves up to that sport. Coasting on roller skates is fun, but coasting on one of the regular coasters with foot-board, steering post and brake is, next to flying, pure bliss. Emory S. Egge, of Montgomery, Ala., who invented the coaster illustrated by the accompanying diagram, has a claim upon the gratitude of the boys, for his invention will make it possible for many who could not afford high priced coasters, to indulge in the coasting sport. The device is extremely simple and can be used with any pair of roller skates. The skates are attached to two blocks underneath the footboard by strap and clamps. The rear block is fastened to the footboard, and the one in front to the steering post. The brake, a plain lever arrangement, is worked through a slot near the steering post.


Homemade coaster made from board and pair of roller skates

Portholes in an Airplane Hull

The engines are carried separately and the pilot occupies the fuselage alone

A Real Aero-Cruiser with an Enclosed Cabin to Shelter the Crew

This new Morane-Saulnier biplane carries two machine-guns and three passengers. Note that the engines are carried not in fuselage or body, as usual, but are independent of it. The fuselage itself is provided with portholes to admit light and to permit observation. The two funnels are used for taking photographs

EARLY in the war high-powered, weight-carrying airplanes appeared which were driven by two engines. But the engines were not housed in the fuselage or body in which the pilot sits, but were actually separated from it. The system has since been improved, as the accompanying photograph shows.

As soon as the engines are taken out of the central fuselage or body, new possibilities begin to appear. The designer has full liberty to shape his fuselage as he pleases. Since it no longer need house machinery, it becomes a regular ship's cabin with portholes.

In the accompanying photograph of the three-seated French two-engine biplane which has been designed by Morane-Saulnier works, the last stage in this development is presented. The plane itself is of rather average size, and yet it is driven by two light but high-powered rotary engines. It must be a speedy machine because of its sheer power and lightness. When the engines are taken out of the central fuselage and mounted between the planes at either side of that fuselage, there is always a saving in structural weight. In the interest of high speed, the fuselage is made deep enough to enclose the three passengers completely so that they are well sheltered from the icy blast that accompanies fast flying at high altitudes.

But how are the men to see? Obviously by portholes. And so we find that the walls of the fuselage are pierced with some fourteen portholes covered with artificial mica (cellon).

Two of these portholes are set in curious short funnels projecting from either side. Obviously they are intended to give a lateral view. But the funnels, useless to an observer, serve to house a long-focus camera and to protect it from the wind. Thus it becomes possible to take photographs in any direction.

Most of the portholes are used to throw light into the fuselage; only the upper ones are needed for observation.

Of course such machines as these could not be used for fighting purposes as they are too unwieldy and too slow of handling.

To Lock the Ends of a Belt, Slip a Pin Through Two Registering Holes

SIMPLE in construction, easily attached and quickly disconnected is a new belt connector which consists of a hinge with a removable pin. One half of the hinge is riveted to one end of the belt, and the other half to the other end. After the belt has been placed over the pulleys, the two ends are brought together, and a rawhide pin is pushed through the alined holes of the hinge. The belt can easily be removed by removing the rawhide pin which holds the two parts of the hinge together. The connector provides a flat and flexible, yet sufficiently strong joint for narrow belts.

Push in the pin and the belt connection is made, forming a strong, flexible joint

Watertight Compartments to Protect Ships From U-Boats

THE submarine war which Germany is conducting against the Allied Powers has caused tremendous losses to shipping already and it is generally admitted that the problem confronting the allied nations is of serious importance. The question, how to check the activity of the submarines is, of course, paramount but next to it comes the question as to how best to protect ships from sinking after they have been attacked by a submarine and torpedoed. The naval authorities of the allied countries are wrestling with the problem of waging war upon the German U-boats, while the ship builders are called upon to find a solution of the second problem.

The accompanying two illustrations, showing the extent of the damage caused to French ships by shell fire and a torpedo form a powerful argument in favor of the use of watertight compartments in the construction of freight-carrying merchant ships. Ships equipped with such compartments will remain afloat a long time and may be able to reach the nearest port in safety, instead of sinking in a few minutes after the attack as in the case of so many well-known boats.

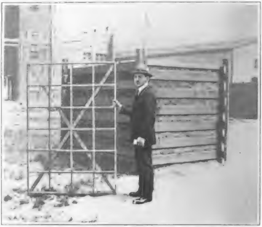
This shows the effect of shell fire on the plate covering of a merchant ship

Photos © Underwood and Underwood

Enormous hole torn in the side of a merchant ship by the explosion of a torpedo

Growing Thirty-Five Bushels of Potatoes in a Six-Storied Box

TALK about growing potatoes in your back yard! Here is a method by which you can grow thirty-five bushels of tubers in a six-by-eight-foot packing-box. It looks like a big pen, but it is a very old thing in the way of potato farms. The western miners have known about it for many years. Now they are passing it on to the eastern folk


A potato farm built on the apartment house principle. Each floor is six inches high and contains one layer

The pens are built of heavy timbers and open spaces are left on all sides to permit the plants to force their way through. The "soil" consists of rich earth and manure with a mixture of hay or excelsior, and each bed is about six inches deep. Potato plants are placed in the first layer of soil and in each layer until the top is reached. The farm is built on the principle of the apartment house, potatoes growing on each floor.

When growing, the plants reach out in all directions, including straight up. When they are fully grown the pen is taken apart and the potatoes are rolled out of their thin covering of soil with a rake, so that they are not bruised and cut. One bushel of potatoes is sufficient for planting. A yield of thirty-five bushels to each pen is the rule rather than the exception. This idea might very well be adopted by city-dwellers here in the East, for the large supply would make potato famines non-existent.

Sun for Ripening Bananas? Certainly Not—Just Cool Them

SUNSHINE is not in the least necessary for ripening bananas. All that is necessary is to subject them to a heat of about seventy-eight degrees for about eight or ten hours, and then gradually cool them to a steady temperature of about sixty degrees. This quickly produces a pleasing golden color, and renders the fruit firm and of very desirable appearance for sending to market.

Swinging "Stop" Signal Attracts Your Eye

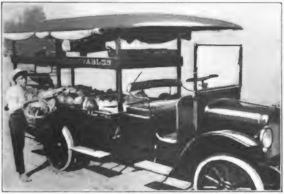
ALL the fundamental principles of safety first are embodied in a signal system for use at grade crossings which has been perfected by a Pennsylvania company. It has three different aspects shown in the accompanying illustration. Under normal conditions the "Stop" signal is concealed behind the "Look! Listen!" sign. When a train approaches, however, the "Stop" signal is released and swings back and forth so as to attract the attention. It is a well-known psychological fact that a moving signal is invariably more effective in attracting the attention than a signal which remains stationary.

The swinging "Stop" signal will catch your eye readily and stop you

If, for any reason, the signal mechanism is out of order and fails to work properly, the "Stop" signal drops down vertically and remains in that position, as a constant warning to all persons approaching the crossing.

The Vegetable Peddler Adopts the Fast Motor-Truck

THE motor-truck is being used in Southern California as a vegetable store on wheels. For some time prior to the use of the truck for this purpose the lowly horse had been used to draw the vegetable wagon up one street and down the next, but so much more efficient is the truck for this purpose that it is being rapidly taken up by California produce peddlers.



California produce peddlers are nothing if not enterprising, and the automobile has, with them, replaced the horse

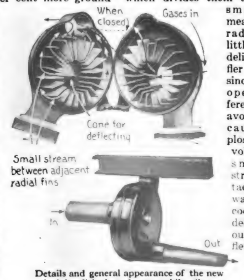
Upon the regular truck platform specially-designed vegetable-carrying bodies are being constructed, the lower deck being the salesroom, while the upper floor is intended to hold the reserve supply. More than thirty per cent more ground can be covered by one of these vegetable-trucks in a day than by the old horse-drawn vehicle. The result is increased profits, a neater appearance and much time saved.

The bodies are of the "quick detachable" variety, so that it is a common sight to see a vegetable vendor and his family touring on Sundays and holidays.

In fact, the money invested in such a motor-truck is considered well-spent by the peddler.

New Automobile Muffler Works on Vacuum Principle

ALL automobile engineers have admitted that the present type of muffler in which the gases are allowed to expand from a small pipe into the muffler and are then carried back and forth through passageways, is inefficient because it increases the engine back-pressure and prevents a rapid exit of the burned exhaust gases. The new muffler is a noise-deadener because it prevents the sudden expansion of the compressed gases to the lower atmospheric pressure. The exhaust gases enter the muffler perpendicularly and strike against a small conical surface which divides them up into numerous small streams by means of two sets of radial fins. These little discharges are delivered to the muffler exit one by one, since the paths to the opening are of different lengths, thus avoiding the noise caused by the explosion of a larger volume of gas. Each small discharge stream is also in contact with the muffler walls, so that it is cooled and its volume decreased on the way out. With this muffler, the gas engine is able to produce more power and efficiency.



Details and general appearance of the new principle, disk-shaped automobile silencer

Don't Let Your Baby Suck the Telephone Cord!

"HELLO! Hello! Is this the complaint department?" A woman's voice, clearly in a state of great irritation, judging from the rising pitch and the increasing explosiveness of her utterance, almost screamed these words to the complaint clerk of the telephone company. He gave an affirmative answer and, interrupted by queer crackling sounds, and a steady buzz, the voice at the other end of the line poured a string of complaints into his ear.

This shows how baby caused a short-circuit in the line by sucking the cord

Bitterly she complained of the operator, of poor connections, noises in the telephone and many other things which, to the experienced clerk, clearly spelled a short-circuit somewhere on the subscriber's line.

Politely he suggested to the woman to examine the green cord of her telephone and to inform him whether it showed a dark and wet spot.

"Yes, it does," came the answer. "Baby was playing with the cord this morning and took it in her mouth, sucking at it for a while. Surely there can be no harm in that!"

The complaint clerk, who had heard the same story many times, was callous. Irate ladies who complained of the service and possessed babies were as nothing to him. If people did foolish things and then upbraided the company, why should he care?

Placidly he informed the complaining one that the baby, by sucking at the cord, had caused a short-circuit somewhere in the line. The insulating fabric around the wires, when thoroughly moistened, had become a conductor of electricity. He advised the woman to dry the spot by holding it for a while near a hot iron and not to let Baby suck the green cord again, unless she was willing to go to the trouble of drying out the wire every time Baby committed the offense.

A New Safety Lock Suitable for Sewing-Machine Treadles

PROBABLY the greatest element of fatigue occasioned by running a sewing machine is that of exerting a constant foot pressure on the treadle while the machine is in operation. To stop the machine, the operator is forced to elevate the sole and lower the heel of her foot. In case of running a needle into the finger, the instinctive motion is to draw away, but she would be forced to make the reverse motion.

Mr. Frank B. Gilbreth, of Providence, R. I., an efficiency engineer, has introduced a device which can be advantageously applied to any sewing machine where the operator does not have to stop the machine oftener than every four minutes. To start the machine, the operator simply pushes her foot down on the treadle. The hooklike device grasps and locks the treadle. To release the lock, the operator has only to drop her foot from the foot rest shown on to the lever. This knocks the catch off the treadle and stops the machine.

This device starts and stops a sewing machine without causing unnecessary fatigue

The first picture shows the Pigeon-Tremex, which destroys trees by boring into them. The second shows the Ichneumon Fly which destroys the destroyer, thereby saving the trees

Even a Parasite May Prove to Be Useful to Man

"BZ-Z-Z-." "Bz-z-z-z-z"—the buzzing sound comes nearer. It is produced by the vibrations of the wings of a most peculiar looking insect. Its body is about two and a half inches in length, with transparent wings marked with dark spots. Hanging straight down from the rear end of the slender body is a thin, hair-like something, about five or six inches long, which seems to interfere with flight.

Clumsily the insect circles around the trunk of the big elm tree. The buzzing ceases. The insect crawls around the trunk for some time before it stops.

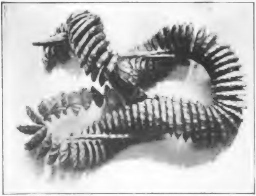
Without further preliminaries the queer insect raises its threadlike appendage straight up, then curves it in form of a loop over its back, so that the sharp tip at the end of it comes down on the bark. The appendage, which seems to have the rigidity of a steel wire, is planted perpendicularly upon the trunk and is drilling a small hole into it with surprising rapidity. At last the drilling ends. With unerring instinct the insect, known as the Ichneumon Fly, has located the burrow of another insect, the large Pigeon-Tremex, belonging to the insect family known as Horn-Tails. The female has drilled through bark and wood with its slender ovipositor until it reached the burrow. It deposits one egg in it.

The Ichneumon Fly is a parasite. It deposits its eggs in the burrows of the Tremex and its larvae, which develop from the eggs in a short time, feed upon and kill the larvae of the Tremex which they find in the burrow. It is the female of the Tremex which drills the tell-tale holes into the bark of our shade trees and deposits eggs in them. The larvae which come from these eggs burrow into the heartwood of the tree unless their career is cut short by an Ichneumon larva.

Reducing the High Cost of Building with Camouflage Lions

This ferocious lion is made of laths and Virginia creeper—cheaper than bronze

MOSES HAMBURGER, of Los Angeles, built himself a new house, and his soul lusted after lions to guard the portals thereof. Accordingly he had built nice inexpensive bodies of laths, fitting them with faces of concrete. Then he planted Virginia creeper with the result that he now has two magnificent camouflaged lions.



Look at it, guess what it is and then read the accompanying article. It isn't a centipede or snake

Have You Ever Found a Thing Like That?

VISITORS to seaside resorts on the Atlantic coast occasionally find in their strolls along the beach, especially after a storm, strangely formed objects like that shown in the accompanying picture. What is it? Many a stroller has asked himself that question, without being able to answer it. The first guess usually is that the queer-looking thing is of vegetable origin, probably some seaweed. Few suspect it to be of animal origin.

This object, which almost has the appearance of a frilled "boa," is the egg-case of *Fulgur Carica*, a sea snail.

The egg-case consists of a series of flattened capsules, attached by one edge to a cord. Each one of the capsules shows, opposite the place of attachment, a more transparent spot, which indicates the place where in due time the young individuals developing from the eggs will make their exit. When laying these long strings, the snail goes beneath the surface, and, as the ribbon begins to be formed, it appears above the sand, slowly increasing in length until the whole of its two or three feet of length are formed. Each capsule contains a number of eggs. The family of this creature is represented by about eight species, from Cape Cod to the Gulf of Mexico. The snail's shell is often more than one foot long.

Lofty French Observation Point Near Dixmude

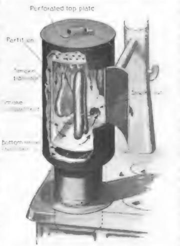
ONE of the essential duties of a soldier is to keep constant watch upon the movements of the enemy. High trees and tall buildings are, naturally, the most suitable places for the establishment of observation posts and are given preference wherever they are available. The tree in the picture, which may still be standing somewhere near Dixmude, was used by the French soldiers, perching securely among its top branches, as observation post to good advantage. The tree, a magnificent specimen, tall and of generous girth, made it possible for the French observer to get a fine view of the German lines. A ladder gave access to the observation post. Even a small crib was arranged near the top, where one of the observers could sleep, while his comrade kept watch.

A French soldier is on observation duty way up in the tree-top

Smoke Your Own Hams with This Portable Smoke-House

THE German *hausfrau* has her own smoke-house which she uses in connection with the domestic stove. It is practically a large sheet-iron can, with a neck at the bottom of suitable width to fit the stove. Inside it is divided into two compartments. A partition is placed on one side which connects at the top with a perforated plate (wire gauze would probably do), and at the bottom with a solid plate forming the bottom of the chamber.

The smoke passes up through the connecting pipe, up the back passage, down through the perforated plate into the smoke-chamber, and thence through the outlet into the chimney. Any dirt or soot or cinders are intercepted by the perforated plate. The apparatus is used on the kitchen stove, with a small, slow-burning fire and any suitable smoke-producing material that is at hand.



This smoke-house is used on the kitchen above with a small fire

Just the Thing for a Kitchenette—An Electric Cooker

HOUSEKEEPING in a modern apartment, although its space economy is carried to extremes, can be simplified by the use of the portable cooking box invented by Mr. Leoline Edwards, of Twickenham, England. It is essentially an improved "fireless cooker" of simple construction, in which the heat necessary for cooking, baking, boiling or broiling is supplied by an ordinary incandescent electric lamp.

The cooker is eighteen inches high and twenty inches square and weighs thirty pounds. It consists of two iron cases, one inside of the other, but separated by a thick filling of expanded cork. Through a hole in the lower part of the box the socket of an electric lamp is passed, which may be connected with any convenient plug or lighting fixture. To the socket an ordinary electric light bulb is attached inside the box. Above the heating bulb several shelves are arranged, so that several dishes may be cooked at the same time. The cooking box may be opened by the housewife at any time for the inspection of the contents, which cannot be done with the ordinary "fireless cooker," for the lamp will soon replace any lost heat.

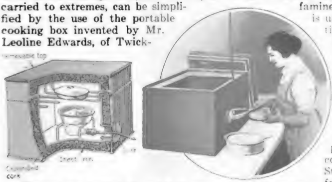


Diagram and method of use of a homemade electric cooker
It is a kind of improved "fireless cooker," simply constructed

Pity the Salt Industry: It Makes Little Profit

A RECENT investigation by the Bureau of Mines proved that a salt famine in the United States is unlikely. At the same time it was established that owing to the low price of salt and the abundance of its supply there is but little profit in the salt industry, although the American salt works have supplied in recent years practically all the salt consumed in the United States. What a pity—for the profiteers—salt is not used in munitions!

Parlez-vous Francais?—If Not, Learn How with Playing-Cards

Members of this party are studying French by means of a special American-invented card game. The cards are shown held in the hand at right

AN ingenious American inventor has recently put on the market a card game invented by him, which is designed to teach French, or at least the rudiments of the language, by means of a game played with a special pack of sixty-one cards.

The cards are numbered from 1 to 60 and in addition there is a "joker." Each card has printed upon its face a top line giving some French word or phrase, with its phonetic equivalent and an English translation. Under that, in a frame is, in French, the answer to a question printed on the card with the next lower number. Under that is a picture, bearing upon the answer in the frame. Still lower is a question in French, with the phonetic equivalent and English translation, together with the French answer and its phonetic equivalent, but without translation. That answer is repeated within the frame near the top of the card with the next higher number. At the bottom of the card there is some grammar comment and vocabulary and so forth.

Number One reads the question on his card; Number Two reads the answer as given on his card, with its English translation, and in turn, follows with the question to be answered by the next player, and so on until the cards are exhausted. The holder of the joker can ask any player one of the questions upon his card.

They Hung Little Jessie on the Clothesline to Dry

A future story: "When Mama hung me out on the line to dry"

THE little girl on the clothesline is not a victim of Boche atrocity, as some might imagine. She is a little American girl, and the condition of suspense in which she finds herself is merely the result of a happy inspiration. It was wash-day and the mother was extremely busy. The little girl also had been busy around the tubs and being a trifle unsteady upon her tiny feet, she fell into one of the tubs which, luckily, was filled with cold water.

The mother was too busy to change the child's clothing and so she fastened the little toddler to the clothesline by means of her dress and some clothespins.

Trapping Salmon in the Far North

The people of the North spear thousands of salmon in dammed streams

By Christian Leden

The salmon are caught in stone traps after which they can be speared with the Eskimo Kakimaks or three pronged forks. The Eskimos catch thousands of fish in this way

AMONG many Eskimo tribes, salmon fishing is one of the most important means of existence. The natives along the West Coast of Hudson Bay fish for salmon the year around, only varying their methods to suit the changing seasons.

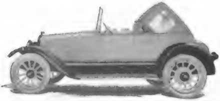
In the Summer, the salmon in the ocean, just beyond the rivers, are caught in primitive nets. During the Autumn when the salmon leaves the salt water the Eskimo builds several stone walls across a river, leaving one stone out in each division, except in the wall highest up. This leaves a free passageway for the salmon as it goes up the river with the incoming tide. When the tide turns, the Eskimos close the openings in the lower walls, and at the ebb, they wade out into these small compartments and spear the trapped salmon with their Kakimaks or salmon-spears. This slaughter of salmon takes many days. They get many hundreds—sometimes thousands—of salmon in one river.

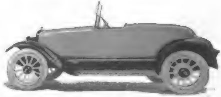
Later in the Winter, when the ice has formed on the lakes, holes are cut in the ice through which to angle for the salmon. This is done by attracting the salmon with a little piece of walrus ivory carved to look like a fish. The decoy is kept moving by the help of a line of deerskin sinew. When the salmon approaches to examine the little imitation fish, he is speared with the Kakimak that the Eskimo holds in his right hand.

In Spring, when the poor salmon gets rather hungry, it is easily caught with a bait and fishhook. Then, even the women go out and angle for the harassed fish, through the holes in the ice. It is fortunate for the inhabitants of that inhospitable region that salmon are plentiful there at all times, at least sufficiently so for the simple wants of the Eskimos, otherwise times would be very hard.

Three Automobile Bodies in One

Here is a car body that can be changed on the road to any of three styles





The Body in Process of Transition and in Use as a Runabout

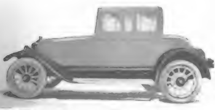
The changes are made by the use of a folding and sliding superstructure. When the car is used as a runabout this is slid back and swung down on a hinge into the rear seat portion of the tonneau. To change to a landaulet the superstructure is raised to a vertical position and side panels are opened out from the front portion of the body to enclose the sides. The coupé is made by sliding the entire top forward in slots that are provided in the sides and swinging up a rear deck from under the rear seat to fill up the space left

"WHICH automobile do you like best?" Ask a woman and she will name the one with the body that most appeals to her. Ask a man and he too will express his taste in terms of the body. For the body is the most exposed part of the car; it expresses a car's individuality. As a result, there is a greater and greater demand for bodies of distinction or for those which have some particular feature that the greater number lack.

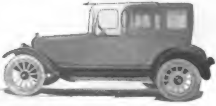
With the demand for better looks in automobile bodies has come an equal demand for greater comforts as expressed by convertible bodies which can be thrown open to the gentle breezes in the balmy spring days or closed and heated in the bleak winter months. One of the most ingenious automobile bodies designed to fulfill these conditions of individuality and comfort is that shown in the accompanying illustrations. It is really three bodies in one, for it enables the car to be changed in a few minutes into a runabout, a landaulet with the driver outside and the passengers in their own compartment, or a coupé with the driver and the passenger on one enclosed crosswise seat. These transformations may be made on the road at any time and without the addition or removal of any parts, whereas in the early days of body design, such transformations would have necessitated the employment of three separate chasses, each with its own particular body.

The metamorphosis is accomplished by using a sliding and folding superstructure. This can be folded down and concealed, or raised and used in either of two positions, thus forming three distinct types of car.

The advantages of such a body as this are obvious. One has a universal car, suitable for all occasions, and all weathers.



This is the convertible body as it appears when it is used as a coupé

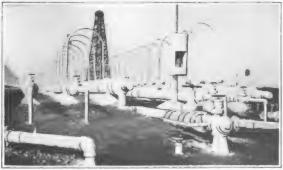


Showing how body is changed from coupé to landaulet by sliding top back

All th[illegible]cialized knowledge and information of the editorial staff of the Popular S[illegible]hly is at your disposal. Write to the editor if you think he can help you.

The Very High Cost of Writing Letters

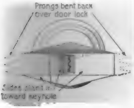
HAVE you ever figured out the cost per letter of your business correspondence? Taking into consideration the cost of stationery and stamps, the salary of the stenographer, cost of all accessories to the typewriter, all overhead charges, and last, but not least, cost of time of the man who dictates the letters, it works out at forty cents per letter, and that is an absolute minimum!



Why this formidable-looking array of pipes? Just in order to separate natural gas from oil

That Elusive Keyhole Simply Must Be Found

THERE are times in the life of most jolly good fellows when they find it quite difficult to find the exact geographical location of that narrowly circumscribed opening into which their latch key is supposed to fit. But even persons not included in the class of good sports often have difficulty to find the keyhole, particularly at night or in cases where the door is located in a dark hall or corridor. The key hole guide invented and patented by Ernest E. Brown of Waukegan, Ill., is designed to give relief in all cases where the finding of the keyhole is, for any reason, connected with difficulties. These guides, which form a kind of trough with sides slanting toward the keyhole, are hammered into place over the regular doorplate, and conduct the key unerringly to the keyhole with absolutely no effort at all.



Showing construction and application of the handy keyhole trough herein described

Oil and Gas Mix, and So They Are Separated Out West

MANY oil wells yield both oil and gas so, with such a plant as is shown, the flow is forced directly from the well into a large main pipe. The gas separates from the oil and rises to the top of the pipe, passing over through the small inverted U-shaped pipes and into the smaller main.

For many years natural gas in oil wells was considered a nuisance and was allowed to waste, but now, on account of its fine heating, fuel and power qualities, large investments are made to conserve and utilize it. The day of the picturesque burning gas well, lighting the country at night for miles around as an advertisement of a natural gas region, is practically a thing of the past. Such a spectacle is rarely seen now and when it does occur it is looked upon as an example of poor engineering.

Natural gas is, nowadays, a valuable commercial commodity, and a number of cities use it exclusively in lieu of coal gas for heating, lighting, and power purposes. It is, of course, much cheaper than coal gas.

Making Animals Transparent

We used, as children, to read about invisible cloaks. Read how a rat got his "cloak"

H. G. WELLS once wrote a striking story about an invisible man, who owed his invisibility to the fact that a method had been discovered of rendering the refractive index of his body to light exactly the same as that of the atmosphere. In other words, his body became absolutely transparent and hence invisible.

Perhaps the principle may be better understood if we consider the case of a glass tube. Ordinarily the tube reflects lights and objects. Placed in water, the tube becomes much more transparent; but placed in a liquid having the same index of refraction as the material of the glass, the tube is hardly visible at all. On the other hand, "ground glass" is opaque because the rays of light are bent; the surface of the glass is so broken up that the separate rays of light do not pass through in a direct line at all.

That Wells was not merely romancing is strikingly demonstrated by the accompanying photographs which were made for the POPULAR SCIENCE MONTHLY with the consent of Doctor Harmer of the British Museum. The trustees of the Museum applied to the proper British authorities for permission to use the discovery disclosed in a German patent granted to Hermann Streller of Leipsic. Streller actually patented what appears to be a valuable process "for rendering organic and inorganic bodies transparent and translucent" by juggling the refraction of light in the way proposed by H. G. Wells in his story.

The rat that Doctor Harmer treated passed through more than one solution before he was reduced to comparative transparency. First of all the rat was stripped of his fur overcoat. Reduced to stark nakedness, he passed through solution after solution. Like all other animals, a rat consists largely of water. This was removed and he was immersed in weak alcohol. Gradually the alcohol was strengthened until the water was all expelled, and the rat was practically pure alcohol. Then a fluid was intro-

invisi-
body

Here are three objects—opaque, semi-transparent, and transparent. Note the rat's bones

duced which mixed equally with alcohol and with oils. Eventually the rat was converted into pure benzol in order to get rid of the alcohol. At any given stage he was filled with some liquid to prevent him from collapsing. Finally an air pump was used. He passed through a vacuum into the liquid with the same index of refraction as his own. The vessel containing the liquid was then sealed.

It is of course impossible to obtain absolute transparency. The different parts of an animal's body have different indices of refraction. But it is possible to make certain groups of muscles disappear if their index of refraction is known. A mixture of three parts of salicylic methyl ester and one part of benzyl-benzoate is a liquid which has an index of refraction corresponding with that of most animal tissues. According to Professor Spalteholz, human bone can be revealed by using five parts of oil of wintergreen and three of benzyl-benzoate.

A new hoeing machine which imitates well the strokes of the human arm

The Weight of This Dumbbell Can Be Changed

FEELING particularly strong and vigorous this morning?—Add another pound or two to each of your dumbbells. You can easily and quickly do that if you own a set of the variable weight dumbbells recently invented. As may be seen in the diagram, each end weight is rounded and attached to the handle section by a long machine bolt with counter-sunk head. By unscrewing the head sufficiently it is made possible to insert one, two or more extra weight-disks between each end piece and the handle section. The extra weights are slotted so that they may be slipped into place without entirely removing the end-piece and screw bolt. After the bolt screw has been tightened the curved flange holds them so that they cannot slip.

Now all you athletes, go ahead and rival Sandow.

This dumbbell can be adjusted to suit the "pep" of the user

It Does the Work of Four Men—This Hoeing Machine

A HOEING machine, invented by Otto F. Ullman of Severy, Kansas, operates several hoe-blades simultaneously. It does the work of three or four men armed with hand-hoes. Only one man operates the machine.

The hoe-blades are fixed to the lower ends of arms suspended from a crank-shaft. Bars extending from the hoe arms to rocker arms at the rear of the machine regulate the movement of the hoes, imitating the strokes and motions of an ordinary hoe worked by hand. The crank-shaft that drives the hoe-blades is connected by a chain, sprocket-wheels, a gear-shaft and gears with the main or driving axle. The device may also be arranged to be driven by power from a small gasoline engine, but it is not very hard to run by hand.

Housekeeping Made Easy

A mahogany chiffonier having one drawer made into a handy writing desk

A portable electric nitrogen bulb radiator made in the form of a steam or hot water radiator

Cleverly designed cigarette box shown above

Five ash trays in holder for the smoker's private den

An immersion electric heater which cannot burn out is shown at the left in use in a tumbler

Requiring practically no effort in operation, this sweeper collects all crumbs when pushed over the table-cloth

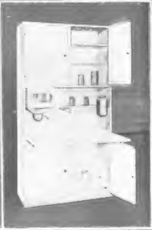
The utensil shown at the right is made of porous material and serves as a refrigerator by the evaporation of water through the sides

The book rest shown below makes reading in bed more pleasant

Housekeeping Made Easy

Attractive molds for making the mud pies which are so much enjoyed by most youngsters

This suction cleaner is mounted on large casters with ball bearings and rubber tires for moving it about easily from room to room



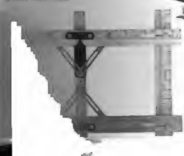
The delivery of china is made much more efficiently and with less damage by the use of a special padded trunk shown at right

Butter making on a small scale is tiresome but this machine greatly lessens the unpleasantness

There is nothing quite so enhancing to the kitchen as a handy cabinet nicely enamelled white

A curtain stretcher frame is shown below which has an attached easel to hold it instead of standing the frame against the wall

Different types of stands for smokers, which are three feet high and finished in natural colors



This trick bottle is made especially to "soak" movie actors over the head

The Bottle Breaks, But Not the Head of the Villain

BREATHLESSLY the spectators are watching the bewilderingly rapid development of the drama on the screen. The hero, singlehanded, defies the villain and his henchmen, while the heroine, whom he protects, is hiding her face. Neither she nor the hero notices the sneaky "Greaser," who, armed with a big whisky bottle stealthily approaches the hero from behind.

The descending bottle breaks into bits over the head of the hero, who drops in his tracks.

But, do not fear; the bottle was actually broken, but the hero remained unscathed. The M[illegible]n's deadly w[illegible] of the recently invented "break-away" bottles.

For a long time artisans in the motion-picture industry have tried to devise a transparent "break-away" bottle, that is, a bottle which would have all the properties of glass except that it would not cut or scratch. Until recently the bottles used were made of an opaque substance which would shatter readily, but which was not transparent. The problem has at last been solved in the modeling department of the Balboa studio in California. William Dummer, chief of that department, has invented such a bottle. The material from which it is made, a combination of ether, gelatine, resin and oil, will crack and break like glass, but it will not cut and may be shattered over the head of the hero without in the least marring his manly beauty. And, what is equally important, it is transparent.

This Pocket Drinking-Cup Folds Up Like a Purse

AS a matter of sanitary precaution every man, woman and child should carry an individual drinking cup. The health authorities have long recognized the importance of permanently banishing the unhygienic and disgusting public drinking cups and have strongly urged everyone to carry his own cup.

This cup is made of aluminum and oiled silk and can be folded up flat

One of the difficulties in the way of carrying out this reform was the lack of drinking cups that would fill the requirements of hygiene and be so fashioned that they could easily be carried in the pocket. The cup shown in the picture consists of two aluminum plates, connected by a strip of oiled silk folded in bellows fashion. The edges of the aluminum plates are folded over the edge of the silk and crimped tightly.

The site of this building was excavated from a hill-side, and the building comprises garden, garage, tennis court for both night and day and skating rink

A Garage, Tennis Court, Skating Rink and Garden in One

ALFRED AUDET, a Salem, Mass., man. has constructed for his use a combination garden, garage, tennis court and ice skating rink. This roof garden is built into the side of a hill in the rear of the dwelling. The hill was apparently a barrier to further development of the property, but it was eventually an advantage. The garage space is hollowed out of the hill. The garage measures thirty-eight by seventy-seven feet and comprises six separate houses to accommodate three cars each. Every compartment is thirteen by thirty-eight feet, with electric lights and hot water heating.

The dirt taken from the hill was placed on the roof of the garage for the tennis court and garden. Electric lights permit play at night. A wire netting thirteen feet high set in the large cement posts prevents balls from landing in the street below.

Besides the tennis court there is a spacious garden which makes a veritable bower of beauty. A pergola thirteen feet square and lighted by electricity is a feature of the garden.

The roof of the garage and the base of the tennis court and garden are of cement, ten inches thick. The whole makes a novelty in construction that is a delight to the many suburbanites who have seen it.

Utilizing the Waste Heat from a Gas-Engine

FOR a long time the waste steam from steam-engines has been turned to good account, but there have been difficulties in the way of using the exhaust gases from a gas-engine as they readily attack the metal of the conduits. However, the difficulty is being overcome, for a New Jersey candy factory has an installation in connection with a sixty horsepower engine which is used to heat the factory. The gases pass through an economizer made of cast-iron, with the passages to the different sections staggered so that all parts are heated for the whole length. Water circulates in jackets surrounding the gas passages.

Enjoy Your Snapshots Better by Enlarging Them

If you are an amateur photographer with a hand camera for making only small pictures it will add a great deal to your enjoyment of them if you can enlarge them or, still simpler, look at them with an enlarging contrivance like that shown in the picture. The device is merely a five-inch concave-ground mirror set upright in such a manner that it reflects the picture facing it.

This concave mirror enlarger gives "depth" to your snapshots without trouble or expense

The frame of the mirror is hinged to a board, which forms the base of the device when it is in use. Three slots, for obtaining three degrees of enlargement, are provided in the base and hold the picture to be enlarged. No focusing or adjusting is necessary.

Looking at snapshots with a lens is always interesting for it gives them "depth" and perspective. The camera being a one-eyed instrument, the photographs lack this in the ordinary way. The lens-mirror remedies this. Frame and case are covered with black leatherette, and the whole device folds up to a package one inch in thickness and six inches square. Amateur photographers who have used this contrivance have found it a valued part of their equipment.

Grocery Store Has Combination Front and Awning

When William Judd built his grocery store at Avalon, Santa Catalina Island, he had to have a front to the place, and he also needed an awning. So, instead of going to the expense of providing both, he combined the two.

Mr. Judd considered that he didn't need an awning when his store was closed, and when it was open he didn't need a front. So he set to work and built a rather substantial awning on a frame that works on hinges attached to the building. The awning is provided with hinged legs swung to the lower edge, which fold upward when it is lowered.

At the end of the day it is only necessary to fold up the legs, lower the awning, and lock it. When time to open the store in the morning, the front is unlocked, and raised into place to serve as an awning.

This arrangement is very neat and very convenient, but it appears to be only suitable for mild climates, and among strictly and universally honest communities, as its rather flimsy construction would not keep either weather or persons out for long. So Mr. Judd's novel grocery store front attests the confidence he has in Avalon folk.

the latest thing in grocery store fronts, well adapted to warm climates. When the store it is a very effective sun-awning, and when the store is closed it forms the front wall

Cleaning Billiard Tables by an Electric Brush

THE cloth of billiard and pool tables takes up a great deal of the chalk dust that drops from the cues. How can it be removed without ruining the cloth and without merely raising it into a cloud that settles again upon the cloth? When vacuum cleaners came into use, many owners of billiard halls tried them upon their tables, but unsuccessfully. The powerful suction loosened the cement between the slate plates forming the bed of the table and in a short time wore off the nap of the cloth.


This rotary brush and vacuum cleaner cleans billiard tables without damage

An electric brush, which was invented by Mr. Dolph L. Lowery of Sandusky, O., avoids the undesirable features of the vacuum cleaner.

The contrivance has the appearance of a large flatiron and moves on swiveled wheels over the cloth. A small electric motor furnishes the power for a rotary brush in the front part and a suction fan in the housing in the rear of the motor. Loosened by the bristles of the brush, the chalk dust is drawn through a tube to the center of the fan and blown into a bag connected with the fan housing. The excess air is allowed to pass out of the bag through strainers which hold back the dust.

As all billiard players know, it is absolutely essential that the surface of the table shall be perfectly true, and great difficulty has been hitherto experienced in cleaning the cloths, as even a soft brush is likely to raise the nap and cause an infinitely small unevenness, which, nevertheless, may upset the accuracy of the table to a noticeable degree.


© Western Newspaper Union
Patriotic women are operating knitting machines to speed up the war work

A Pair of Socks Every Thirty-Five Minutes—Red Cross Knitters Please Notice

THE enormous demand for sweaters, scarfs, etc., for the American soldiers and sailors made it clear that this war work needed speeding up. So the Comforts Committee of the Navy League of the United States installed in its headquarters several knitting machines and turned them over to the women. Even the most expert knitter cannot knit much more than one pair of socks a day, while a machine like that shown in the picture, if skillfully operated, can turn out one pair of socks every thirty-five minutes.

The Richest Food in the World

Solving the food problem with the Soya Bean

By Hudson Maxim

Hudson Maxim is the inventor of smokeless powders used by the United States army and navy. He is America's foremost authority on high explosives. As a member of the Naval Consulting Board, he has given up much of his time to the consideration of war inventions. The food problem seems to him the most important of all, and here he suggests a method of using the Chinese soya bean in solving that problem.—Editor

Hudson Maxim is now turning his attention from explosives to the study of foods

IN my book, "Defenseless America," published three years ago, I called attention to the defenselessness of this country, but in that book I dealt mainly with our lack of preparation in respect of fighting men, fighting ships, and all the munitions and military equipment of war. All my conclusions in that book have been most emphatically verified by results since our entrance into the present war.

But there was one very important phase of our unpreparedness for war which I did not mention and that was the food problem. The provision and distribution of food has proved to be one of the main problems of the war, and the solution seems farther off than ever. Present tendencies indicate that the time is near when the production and proper disposition of food to our own people, to our Allies and armies over-seas will be the most baffling task which we shall have to accomplish.

The food problem is a three-in-one problem—first its growing, second its transportation, third its consumption.

There is enormous acreage in the United States, not at present profitably employed, which can be devoted to raising some of the most nourishing and valuable of foods, provided that the market price and means of transportation were such as to make the work profitable to the farmer. Throughout the South, especially, are large areas which have been abandoned because of the cotton boll-weevil. These areas could be very profitably employed in raising a great variety of foods not at present cultivated to the extent which they ought to be raised. Among these the principal is the Chinese soya bean, a food which is so rich in fat and protein as to outclass

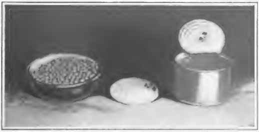
Here we see the soya bean being handled in quantity in its native country. Note the peculiar topped baskets

the popular beefsteak in nutritive value.

But the soya bean is unlike the common American product in that it requires special treatment in its preparation to make it suitable for human food. I have been studying the soya bean for several years and have succeeded in producing a soya bean product which I call So-Soya. This product is a food-conserver, because it is not only highly nutritious in itself, but because it adds nutritive value to food with which it may be mixed.

Thus it becomes possible to use many foods of low nutritive value and to give them the nutrition they lack by the addition of my products. When mixed with almost any other food in the world, it improves both its taste and nutritive value.

The beans must be ground in producing the new food. Mr. Maxim is putting beans in the machine



Mr. Maxim believes that the soya bean products will eventually appear on every breakfast table

The food is prepared in the form of a very dense, stiff paste, somewhat resembling peanut butter in general appearance, but So-Soya being a complete food it is far more palatable in the pure state than peanut butter.

The following are some of the most important uses of this new food concentrate.

It may be eaten on bread, crackers or toast, or with potatoes, without any previous treatment. It makes excellent sandwiches. By mixing together equal parts cow's butter and So-Soya, the butter is doubled in quantity and for the purpose improved in taste.

By merely adding hot water, So-Soya makes a delightful soup. Hot milk thickened with it makes one of the most delicious soups that could be desired. A plate of it makes a meal for most persons, such is its nutritive value.

Mixed with cold potatoes in the proportion of one part So-Soya to three parts potatoes and heated either with or without the addition of a little milk, a dish is made that is a decided improvement on the usual form of re-heated potatoes.

Used as a thickener for all kinds of gravies and meat sauces, it improves them. In all kinds of dressings for meat and fowl it serves as a most decided improver.

Ordinary round steak, chopped fine, mixed with So-Soya in the proportion of three parts of meat to one of So-Soya, thoroughly incorporated, and broiled like an ordinary steak, is at once both most delicious and tender.

An ordinary beef shank stew, made by cooking the meat until it falls to pieces, then thickening it with So-Soya, makes a dish that has a flavor somewhat resembling terrapin.

Ordinary tripe, boiled until thoroughly done, with onions and butter added and cooked until the onions are done, and finally thickened with So-Soya, makes one of the best and most palatable dishes of all.

So-Soya is especially adapted as an all-round Army ration. There is no one thing on which the soldier can march longer and be sustained than on So-Soya, and there is no one thing that may be eaten more continuously with relish and without cloying the appetite than So-Soya. The reason for this is that it is a well-balanced food and one that partakes of the combined properties of vegetable, fruit and meat and is therefore satisfying.

Lest it be thought that I am trying to advertise So-Soya through the editorial pages of the POPULAR SCIENCE MONTHLY, I may state here that the product has not been put upon the market, and as yet I have taken no steps to that end. I have been negotiating with the Government in an attempt to get the Government to manufacture the food and supply it to the Army. For this purpose I have offered the Government the free use of my inventions in foods during the war, if they will utilize them for any purpose they see fit.

The Burglar Makes a False Step

THE night is dark and cold. Someone is stealthily moving in the shadow of a residence. When the policeman, patrolling the beat disappears around the corner, a man, with his face muffled, slinks up to a house. "What a snap!" he murmurs.

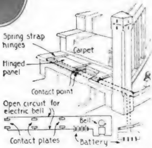
Drawing a few skeleton keys from his pocket, he begins operations upon the inner door. The lock, a plain one, yields in a few moments. He enters the pleasantly heated hall. He knows his ground, knows where the stairway is that leads to the second floor, knows how to get to the room on the second floor where the family jewels may be found.

Softly he feels his way to the stairs. There is the first step. He raises his foot and plants it upon the first step. In a moment the scene is changed as by magic.

Stairs and hall are illuminated by a flood of electric light and—"Curse it!" snaps the startled burglar, as he hears the resounding din of a big electric alarm bell, loud enough to awaken everyone in the house. "that means git in a hurry or they'll nab me!" He turns and quickly makes his exit without standing upon the ceremony or order of doing it.

The burglar commences warily to climb the stairs but he reckons not on the stair alarm

It was his first step on the stairs which had caused all this trouble. He knew where the stairs were but he did not know that the first step was hinged on a spring hinge so as to break an electric circuit while the step was not in use, and closing the circuit by the weight of a person pressing the three contact points of the movable part of the step against the corresponding contact points of the base underneath. The electric current thus put into action automatically switched on the lights and sounded the alarm gong, informing the whole household of his undesired presence.



Just as he touches the fatal step the little burglar-alarm, which is shown here in detail, operates

Dummy Ships That Fooled the Germans

Their "suicide fleet" of imitation dreadnoughts a huge joke

Because of their utter helplessness in the event of attack, the British naval officers who knew of this wooden hoax referred to the fleet as "The British Suicide Squadron"

THE sinking of two wooden 'dreadnoughts' by Great Britain, some days ago, to form a breakwater, brings up more evidence of what disposition is being made of the dummy fleet of fourteen battleships with which Great Britain fooled Germany for some fifteen months during the earlier part of the war.

This titanic war jest, which was recently exposed by Lieutenant Henry Clay Foster, with the consent of the British Admiralty, completely deceived not only the Germans, but the English people themselves. No one in England was able to explain *how* the Germans could claim to have sunk the *Agamemnon* at the Dardanelles, when the Admiralty had admitted, officially, the sinking of only the *Goliath* and "some supply ships."

Germany rejoiced over this supposed sinking of the *Agamemnon*. But they must have wondered why the turrets and "guns" of the sunken dreadnought floated, for days, in the Dardanelles.

Lieutenant Foster states that the dummy battleships were converted from old third-class passenger ships of the Canadian Pacific Steamship Company, which were enrolled in the English Navy.

In an Irish port, says Lieutenant Foster, the dummy battleships were painted in exactly the same hue as the vessels of which they were counterfeits. Canvas was stretched over the decks and painted gray, and the upper decks and equipments finished in every detail to resemble the Grand Fleet ships so that any foreign aviator—or any British one, for that matter—flying overhead, would never suspect he was looking down upon any other than a member of the Grand Fleet.

Turrets and guns were all made of wood, with a careful exactitude in their outer color and finish. There was nothing real about the ships, so far as war purposes were concerned, except the brass trimmings, which were kept shining, as on a battleship, and some lifeboats, in which the crew were required to drill. The ships had neither speed nor defenses. Not one carried a real gun.

Jumping Through an Aerial Bonfire

One of the most sensational episodes of the great war

By Carl Dienstbach

THE great war has led to many radical changes in the methods of warfare. Some were discontinued altogether, others modified, still others greatly developed. The trench-warfare, which reached a higher development than ever before, naturally influenced the artillery tactics and led to an extensive use of observation balloons. These balloons, which were and still are used on all fronts, are essential for directing the fire of the artillery and have amply demonstrated their usefulness. The destruction of the enemy's balloons is one of the most important tasks devolving upon the aviation branch of every army. It might be said that it is part of their daily routine to seek and, if possible destroy, by gunfire or aerial bombs, the observation balloons which direct or correct the fire of the enemy's artillery.

Collision was inevitable. The airplane dashed clear through the burning balloon

It was one of those attempts to destroy an enemy observation balloon on the Italian front which led to one of the most sensational episodes recorded during the great war. One of the allied flyers, having ignited the gas of the hostile balloon, dashed with terrific force through the [illegible]ly blazing bag and, although dis[illegible] by the shock, succeeded in landing behind his own lines.

[illegible] is nothing very sensational or [illegible] in the circling of an airplane [illegible] an airdrome, while on the other [illegible] most daring fiction has never [illegible] and pictured anything half as [illegible]ul and sensational as was that [illegible]ash of that allied airman clean [illegible] burning hostile observation balloon, three thousand feet above the ground. It was another incident demonstrating the dramatic possibilities and the element of romance in flying.

Four ally flyers attacked the hostile observation balloon, which was guarded by three airplanes. While each of the allied flyers engaged one of the hostile flyers in combat, the fourth flew straight for the balloon, opening fire with incendiary bullets at short range. So intent was he upon the destruction of the balloon that he miscalculated the distance. When he found that it was too late to avoid a collision with the burning balloon, the daring airman put on full speed and, withour hesitation, dashed straight through the fiery monster.

The wings of his airplane were broken by the shock but the stays and braces held them long enough to enable him to glide down to safety behind the lines of the Allies. Tattered pieces of the bag of the balloon were still clinging to the wings of the airplane when it reached the ground, grim evidence of its sensational dive, unparalleled in the history of aviation.

Had the fabric not yielded, or had not the gas been ignited before the collision, this airplane would undoubtedly have shared the fate of the Austrian airplane which, a short time before the beginning of the war, accidentally rammed an Austrian dirigible, was upset and crashed down in flames, entangled in the folds of the burning balloon. The result was complete disaster.

Before the war this part of the Belgian border contained the most beautiful country roads, shaded by magnificent old trees which the retreating Germans cut down by the thousands

A Beautiful Section Laid Waste by War's Iron Heel

THAT part of Flanders which is located between the Belgian border and the Somme river, was known before the war as one of the most fertile and beautiful agricultural districts of northern Europe.

When the British undertook their drive toward Cambrai, the retreating Germans cut down thousands of the trees lining the country roads and placed them across the roads to hinder the progress of the British.

The Lawn Roller Becomes a Weapon of War

ALTHOUGH conceived primarily as a war machine of unlimited possibilities, the invention upon which J. L. Hyland, of Minnesota, recently obtained a patent, can also lay claim to a wide range of usefulness in times of peace. A hollow cylinder, approximately seven feet long, has a shaft or axle around which it can be rotated. To the ends of this shaft a steering frame is fitted, similar to that of a lawn roller. By means of the steering frame the roller with its contents may be rolled toward the enemy by two or more men, who are protected from gunfire by the roller, which is to be kept between them and the enemy. One or more machine guns may be mounted on the outside of the roller or placed inside of it, so that they can fire through openings in the steel cylinder. When the roller is to be used as a conveyance for men, either fighting men on their way to the front or wounded men to be taken back of the lines, a stretcher is suspended from the shaft by means of hooks, or a semi-cylindrical structure with berths for three men is suspended from the shaft, so that it will swing freely while the cylinder is revolving.

Not a lawn roller, but a machine which protects the soldier from gun fire as well as from liquid fire

Truck Service Overland

Congestion of railroads and scarcity of cars causes long-haul motor truck service to be instigated

By Joseph Brinker

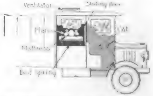
If the truck becomes mired, it is equipped with a power-winch to pull itself out

ONLY a few years ago the plan of establishing a regular freight-carrying service with big motor-trucks over a distance exceeding fifty or, perhaps, seventy-five miles, would have been considered extremely visionary if not impossible. Today a large manufacturing concern in Akron, O., maintains a regular freight service by five-ton motor-trucks between Akron and Boston, a distance of 740 miles one way or 1480 miles for the round trip.

The concern manufactures automobile tires and rubber goods and has a great number of branches in cities along the Eastern seaboard. To these it must deliver goods regularly and promptly. The inability to get cars when needed often meant that some branch would run out of tires and would be compelled to refuse business because it could not deliver the goods when a call came.

On the way. This is one of the trucks which make the seven-hundred-and-forty-mile journey across country

There seemed to be little prospect of an improvement in the situation and, fearing that the railroad congestion would eventually make it impossible for the company to carry on its business, the heads of the corporation decided to employ a number of large motor-trucks to deliver its goods to all of its branches east of the Mississippi River. They fully realized that it would cost more to ship tires cross-country by trucks than by rail, but they would rather pay the additional cost and continue their business than shut down and do no business at all. Nothing is more expensive than doing no business. The expenses of maintaining the factory and the branches continue, as do the interest on the investment, depreciation, etc., whether one tire or a thousand tires are made a day.



Details of bunking facilities. The crew sleep right in their machines

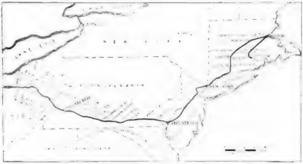
The trucks now in operation make the 740-mile run between Akron and Boston in four days, whereas it took from ten to fourteen days to make the shipment by railroad. When this saving from six to ten days is considered, it may readily be seen that it pays the company to stand the extra cost of truck transportation which is probably somewhere between seventy-five cents and

one dollar a hundred pounds for each hundred miles.

While the war brought about the conditions which made necessary the use of motor-trucks over such long hauls, it also has been directly responsible for the success of the undertaking during the winter of 1917-18. Between forty and fifty thousand motor-trucks will be delivered to the government during 1918. These will be run overland on their own wheels from the points of manufacture to the points of shipment on the eastern seacoast. Close to one thousand of these trucks have already been driven overland since the beginning of the year. The government has demanded that the roads over which trucks have to run must be kept cleared of snow. The states of Michigan, Ohio, Pennsylvania and New Jersey have risen to the emergency and despite the unusual snowfall they have kept a clear cross-country highway from Detroit to New York all winter. This has made it possible to operate the Akron-to-Boston trucks with but few interruptions on account of snow for the reason that from Pittsburgh east through Gettysburg and Philadelphia they follow the Lincoln Highway, the same route over which the government trucks run.

The roads are good, but the grades are sometimes rather steep. Look at this hill

One of the 3½-ton trucks of the Akron concern made the 533-mile run between Akron and New York in sixty hours total time and forty-nine hours actual running time, or at the rate of almost eleven miles an hour for the entire journey. It crossed the Allegheny Mountains after a heavy snowfall and with the temperature at thirteen degrees below zero. A truck-driver that can accomplish this is no novice, and has to be equal to any emergency.



Map showing route followed by the fleet of motor-trucks which is plying regularly between Akron, Ohio, and Boston, Mass.

See that Your Garage Is Ventilated. It Is Dangerous Otherwise

DURING the exceptionally cold months of the past winter, many deaths by poisoning from the exhaust of gasoline engines were reported from all parts of the country. In most cases the victims had been, for some time, in a poorly ventilated or unventilated garage or other room where one or more gasoline engines were running. A careful investigation has established beyond doubt that death in these cases was not caused by the exhaustion of the supply of oxygen in the air, but by the carbon monoxide, an extremely poisonous gas, which is generated by the incomplete combustion of organic substances. It is one molecule each of carbon and oxygen combined. Only thorough ventilation will remove the danger.

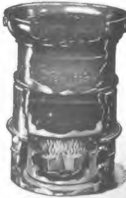
Youngsters are safe on the beaches with this round float

Swimming Harness Will Keep the Kiddies Afloat

TO the numerous devices for the protection of children and grown persons against the danger of drowning a new one has recently been added, which offers some notable advantages. It consists of an inflated circular tube or tire which is fastened to the body of the person using it by a harness arranged in such a manner that it prevents the buoyant tube from slipping down or over the head. The device has considerable buoyancy and will prevent the sinking of any person wearing it. The harness is strong and simple and cannot get out of order. It is a boon to youngsters who are just learning to swim.

Cook Soup, Coffee, and Beans in One Vessel

AN unusually compact and practical mess kit, suitable for soldiers, campers, automobilists and hunters has recently been placed on the market. The kit consists of ten pieces, cleverly nested. It weighs less than two pounds. Alcohol in solid cubes is used as fuel. A glance at the accompanying illustration shows that the lowest two sections of the kit, set up ready for use, form the stove. Set into the upper part of the stove, so that the heat of the burning fuel can reach it at bottom and sides, is a boiler for making coffee. On top of that boiler is another boiler which receives its heat from the steam of the boiling liquid below and which is intended for heating soup, vegetables or any other kind of food. A shallow pan forms the top and may either be used for warming some food which does not require much cooking, or may be turned over and used as a cover. When nested, the kit makes a compact parcel, nearly seven inches in diameter and less than four inches high, held together by a strap which serves as a handle.



When closed this cooker is seven by four inches

The Large Amount of Food That Goes Up in Smoke

HAVE you ever thought how much of the country's food is consumed by fire rather than by human beings? One fire which occurred recently in a grain elevator destroyed 700,000 bushels of corn and 300,000 bushels of oats. Frequent explosions in grain separators also cause an enormous loss of foodstuffs. The United States Department of Agriculture investigated such explosions and found that as many as ten a day occur in the Big Bend country of the Northwest. Barns which have faulty ventilation are another source of food loss by fire because spontaneous combustion of hay and grain is a common occurrence in such places. Sparks from locomotives cause innumerable fires in grain fields resulting in an incalculable amount of damage every season. Much damage is also caused by dropping glowing ashes from cigarettes or pipes, the real cause of more fires, in both city and country, than most people think. Grocery stores which carry inflammable merchandise, such as kerosene, are another fire hazard. Many of these burn each year, destroying a large amount of food. Stable fires which destroy cattle affect the meat supply of the country,—an important item at present.

Planting Tobacco with a One-Man Planting Machine

THE old way of setting-out tobacco, tomato, cabbage, and similar plants, was to wait for a showery day, when the ground was damp, take up the plants, and feverishly and laboriously go over the ground with a "peg" and replant them before the ground got dry again. Now, however, there is a machine on the market that does away with all the waiting, all the feverish haste, and all the attendant backache. In addition the plants are better planted, and very few are lost through withering, while the output is several times that of the old method.

In operation the ground is laid out, and barrels of water placed at convenient places in the field, together with boxes of plants. The large cylinder of the machine is filled with water, and the operator takes the machine and a basket of plants (which can be slung around his neck for convenience) into the field. He stabs the point into the ground, drops a plant down the smaller tube and releases the trap. This inserts the plant into the soil and at the same time waters it and presses it down firmly.

As the machine irrigates the plants as it goes along, it is unnecessary to watch the weather as formerly, and plants that are set out in dry weather do as well as those that are set out in the damper weather.

The machine does away with all the body-racking, backaching stooping over that used to make setting-out the *bête noire* of all market-gardeners. Consequently more pains are taken by the men, as it is no longer a hated job to be got rid of as quickly as possible. In other words, it is a device of this kind that makes market gardening a pleasure.

The machine, slung around the neck, sets and waters the plants simultaneously

© Int. Film Serv.
Roller-carrying frame which enables a boat to be launched from a listed ship

Rolling Down a Ship's Side to Safety in a Lifeboat

A SHIP which is torpedoed rarely sinks on an even keel. Whether it lists to starboard or port depends on the location of the injury. The crew and passengers rush to the high side, clamber into the lifeboats, and drop to safety if they can.

We say "If they can" because frequently the boats strike not the water, but the iron plating of the ship's side.

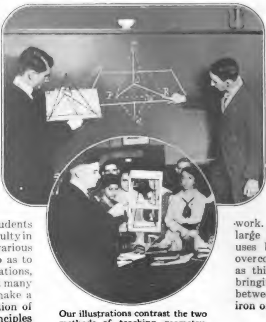
To prevent just such accidents, a new method of launching lifeboats has been invented. A cradle frame is attached to the outside of the lifeboat nearest the ship. If the ship lists, the lifeboat rides down the ship safely on little rollers with which the cradle frame is provided. The frame and its rollers also serve to keep the boat at a safe distance from the sinking ship.

Euclid Never Thought of This Way of Studying Geometry

THE study of geometry, especially of the more advanced branches of spherical and descriptive geometry makes demands upon the imaginative power of the students. Perspective drawings upon the blackboard are grasped only by the more gifted students.

Mr. J. O'Hara Carson, who is connected with a manual training school in New Orleans, found that the students had no great difficulty in learning the various theorems, etc., so as to pass their examinations, but he noted that many were unable to make a practical application of geometrical principles accurately and constructively. A careful study of the subject convinced Mr. Carson that many of the students could not perfectly visualize geometric figures drawn on a plane surface and that it was this fact which made it impossible for them to apply geometry practically. So he invented several models.

The illustrations accompanying this article clearly demonstrate the construction of these models. The planes may be made of wood, pasteboard or any other suitable material, the lines of wire or strings. To differentiate between lines to be proved, construction lines and imaginary lines, different coloring or different material may be employed. These models will also be useful in teaching geometry to the blind.



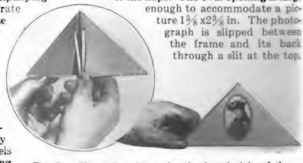
Our illustrations contrast the two methods of teaching geometry

New Uses Have Been Discovered for Blue Glass Electric Lights

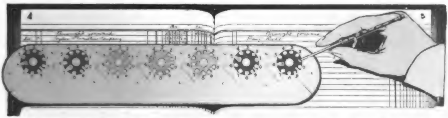
NEW uses are constantly being found for the blue glass electric light incandescents which already have a wide range of uses. A big laundry in the South has installed blue bulb lights for the reason that this light makes the yellow stains in cloth show up plainly, and therefore enables the workers to do better laundry work. In the West a large mining company uses blue glass lamps over concentration tables as this light assists in bringing out the line between the zinc and iron ore.

A Picture Frame and Easel for the "Girl I Left Behind Me"

THIS photograph frame is for the soldier boys. The triangular flaps are folded back, and the loop ribbon provided is slipped around the corner of one of the flaps. The oval opening is large enough to accommodate a picture $1\frac{3}{8} \times 2\frac{3}{8}$ in. The photograph is slipped between the frame and its back through a slit at the top.



The first illustration shows the simple principle of the frame, the second its appearance with a photograph



An ingenious adding device that can be operated on the same principle as a dial on an automatic telephone. It is adapted to the work of accountants and bookkeepers

Simple Adding Machine Convenient to Handle

WITH no keys to press and no levers to manipulate, the simple adding machine shown in the accompanying illustration is particularly adaptable to the work of accountants and bookkeepers. The device consists of a base with seven notched dials representing cents, dollars, and tens, hundreds, and so on up to $99,999.99.

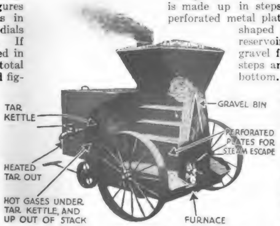
The device operates on the same principle as the dial on an automatic telephone. For instance, if you wish to add $3.64 and $42.80, you place the pencil-like stylus which comes with the machine, opposite figure 3 in the dollars column and turn the dial to the right as far as it will go. Similar movements are made for the 6 and the 4 in their respective cents columns. Inside each dial is a large notch or window and the figure 3.64 will be found registered in red figures in these notches in the first three dials from the right. If $42.80 is registered in like manner, the total will appear in red figures on the four dials from the right.

For subtraction the same principle is used, except that the totals are shown on the white figures. The machine can also multiply.

Heating Tar and Gravel Separately But in One Operation

EMULATING the famous hunter of the olden days who killed two birds with one stone, a New Jersey manufacturer has recently brought out a combination tar and gravel heater that heats these two dissimilar materials quite independently but with one operation. The device, which is shown in the accompanying illustration, is particularly fitted for street paving where block pavements with tar joints are laid.

The apparatus consists of two main parts, a rectangular tar kettle and a Y-shaped gravel-bin, with a furnace extending beneath both parts, from one end to the other. The furnace is fired from the gravel end of the device. The smoke and gases escape through an ordinary stove pipe in the kettle end. The inside of the gravel heater is triangular-shaped while the outside is made up in steps consisting of perforated metal plates. The Y-shaped top acts as a reservoir bin and the gravel feeds down the steps and out at the bottom. The perforations in the step plates allow the moisture in the gravel to escape readily as it is turned into steam by the heat of the fire, thereby making it possible to heat both tar and gravel.



Combination tar and gravel heater device in operation. The furnace is fired from the gravel end

Gulls, which have been fed from a submarine, get the habit of watching for the underwater craft, and thus reveal their presence to the watchful eye of the enemy

Training Sea-Gulls to Become "Spotters" of Submarines

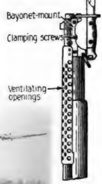
NAVAL officers have frequently had the opportunity to observe that swarms of sea-gulls follow in the wake of submarines. The birds are attracted by the unusual spectacle of a whalelike monster moving through the water, and are eager to pick up garbage.

This observation which, in a few instances during the present war, is said to have led to the timely discovery of the dreaded proximity of a U-boat, suggested to Dr. A. D. Pentz, Jr., of New Brighton, N. Y., the plan of training the gulls to follow in flocks in the wake of submarines. He suggests the use of a hopper, fifty-four inches long, made of sheet steel. It is securely bolted to the top of a submarine and filled with chopped fish. This bait is released from time to time by the turning of a crank operated from the inside of the submarine used for training the gulls. The bait, which would naturally rise to the surface of the water, would attract the gulls and cause them to follow the submarine.

Insulating a Hot Rifle for Bayonet Use

APPRECIATING the fact that a rifle barrel, heated with much rapid fire, is not a particularly inviting article to handle, and that nevertheless it must be handled when it is required to use the bayonet, Mr. Henry Brewer, of Connecticut, has invented an insulating device.

The insulator consists of a perforated metal shield, a little more than semi-circular in cross-section, and sufficiently larger in diameter than the barrel to form an insulating space. It is not at all in the way of the user of the rifle, and as it is merely attached with two or three screws, it does not interfere with the proper cleaning and care of the rifle. The inventor asserts that in view of the perforations in the plate it will give a much better grip than it was possible to obtain before, as manifestly the hand will not slip on the rough plate the way it would on the smooth, hot, rifle barrel.



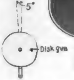
This insulating shield will enable a man to grasp a hot rifle barrel without discomfort or slipping when he makes use of his bayonet

The Mechanical David

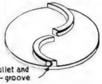
Centrifugal force propels the bullets towards the enemy with terrific force, at the rate of 20,000 a minute

THE present world war has brought out so many striking reversions to primitive principles and methods of attack and defense that the invention of a gun based upon the same principle that enabled David to lay low the mighty Goliath, should, by rights, cause no particular surprise. The gun, which is shown in the accompanying illustration, is the invention of Levi W. Lombard of Boston, Mass. Its general appearance is more that of a feed cutter or coffee-mill, but it is said to be capable of firing 20,000 projectiles a minute with sufficient force to penetrate steel plates three quarters of an inch thick at a distance of several hundred feet, a noteworthy achievement.

Looking down into the hopper from which the bullets are fed to the rapid-fire gun



The Lombard gun is based upon the principle of centrifugal force. A disk, twelve inches in diameter, which is rotated at the rate of 20,000 revolutions a minute, has a curved ridge from its center to opposite points of its periphery. The ridge has a groove on one side, which forms the channel for the bullets. These are fed from the center of the disk, one at every revolution and are expelled by the centrifugal force of the revolving disk. The bullets leave the gun all in the same plane, but not all in the same direction. They come through a slit in the casing of the revolving disk, which represents about five degrees of the periphery. Actual tests have shown that the linear velocity of the bullets (2000 feet per second) is greater than the velocity of the disk.



Photos © Int. Film Serv.

The disk of the gun may be revolved by an electric motor, a gasoline engine or by hand power

It is stated that, no matter what may be the speed of the disk, the bullets always come out at the same place. This result, which involves complicated mathematical and mechanical problems, is obtained by the feeding mechanism and the peculiar form of the curve of the grooved ridge. One of the illustrations shows a top view of the feeding hopper. The gun may be revolved by an electric motor, a gasoline engine or by hand power.

Beware! The Tanks are Coming—Under the Table

OUR picture shows a toy tank with its young commander. This is a most realistic toy, although it is very inexpensive. The sides and body are made of wood, and the gun turrets are merely other scraps of wood nailed to the sides. The gun ports are drilled obliquely so that the guns point forward. Ordinary paper cigarette holders serve as guns—fired in a most realistic manner by inserting fireworks into them. These toys have no motive power, as they are primarily intended for the very little folks, but they make fine stage properties in sanguinary play-room battles. They are not dangerous even for youngsters.

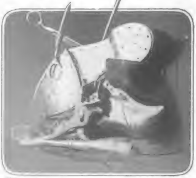
Here is the toy tank in full action. Note the gun being fired

---

Novel Idea of Converting Shell-Cases into Shoe Protectors

TRENCH life is extremely hard on shoes. That has been definitely proved. Rough usage and exposure to mud and water quickly wear them out. For a long time the men in the trenches have tried to devise some method of prolonging the life of soles and heels. It was a bright and happy idea of some French soldier to use discarded shell-cases to strengthen the heels and soles of his shoes. The plan proved thoroughly practical, and soon many other French and British soldiers imitated the example of the inventive poilu.

The shell cases are cut open lengthwise and rolled flat. Then the soles and heels are cut out with strong shears to fit the shape of the shoes and tacked or screwed down. The illustration shows a pair of shoes thus metal-soled and heeled and the tools used in doing the work. It is scarcely necessary to state that both the British and the French authorities encourage this economy in shoe materials.



© Int. Film Serv.

A pair of shell-soled trench shoes and the tools used in doing the job properly

---

Why Isn't It Hotter Nearer the Sun Than Away From It?

WHY is the air generally much colder a mile above the earth than near the ground? The heat of the atmosphere comes from the sun, but by a somewhat indirect process. The incoming sunbeams are only slightly absorbed by the dry air at high levels, and so have little effect on its temperature. In the lower regions of the atmosphere there is always a considerable amount of water vapor (water in the form of gas), and this substance has a relatively large capacity for absorbing heat from sunshine. Lastly, the earth absorbs all the heat that falls upon it, and then gives it back, by radiation or conduction, to the air above it. Thus the atmosphere is mainly heated from below and not from above. Air heated near the ground tends to rise, but it cools rapidly in rising. As it reaches higher levels the pressure upon it is less; it expands, pushing away the surrounding air, and it uses up in this work some of the energy that it originally possessed in the form of heat. This process is referred to by scientists as "adiabatic cooling."

This explains why the heat of summer often seems to come up from the ground, rather than from the boiling sun above.

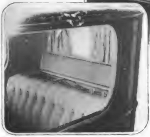
Folding Steering-Wheel Locks Automobile and Makes It Easy to Get Out

THE latest comfort-giving automobile accessory consists of a folding steering-wheel which performs the dual purpose of making it easy for the driver to get into his seat and of locking the car in place so that it cannot be steered if thieves should attempt to make off with it. Folding steering-wheels are not new; neither are steering wheels that can be locked. However, the combination of the two is a new idea of greater simplicity than two separate devices.

Instead of the entire wheel sliding about the top of the post as in most folding wheels, the one shown is hinged at opposite points. The rear half may be swung down and under to permit the driver to stand erect between his seat and the wheel instead of having to slide into his seat.

Here is a new combination folding steering-wheel and steering-lock for your car

This picture shows the side window being fitted to the automobile body



Showing how the windows are stowed to prevent rattling when not in use

Carrying Automobile Sedan Parts Without Rattling

MANY of the convertible sedan automobile bodies carry the side window and door sashes in pockets in the body sides and doors. The result is considerable car rattle, especially when the car is traveling over rough roads. To offset these difficulties, several manufacturers are making the glass panels integral with the frames so that they may be entirely removed and placed in a wider and roomier compartment back of the rear seat, as shown in one of the accompanying illustrations.

Liberty Motor-Cycle to be Worthy Follower of Liberty Airplanes

WELL, we have the Liberty engines, the Liberty airplanes, and the Liberty motor-trucks. Now we are going to have Liberty motor-cycles. The motorcycle is one of the most important factors to the intelligence departments on account of its speed, handiness, and ability to go where an automobile cannot. Accordingly arrangements are being completed to standardize them and turn them out in vast numbers, like other necessaries.

An Enterprising Photographer "Shoots" Draft Army

IT was an event to be remembered when the 10,000 men, forming the New York contingent for the selective draft army marched in parade on Fifth Avenue, New York City, on Washington's Birthday, during a blinding snowstorm. In spite of the unfavorable weather, photographers managed to get many excellent pictures of the parade. Particularly interesting were the motion-pictures taken by an enterprising motion-picture concern which obtained the views in a novel manner. By special permission a giant tripod, towering high over the heads of the marchers and the multitude of spectators, was set up at the intersection of Fortieth Street and Fifth Avenue. From this strategic spot the camera-man, who mounted the tripod with his camera made an excellent and complete record of the parade as it passed that point.

Draft army parade photographed in New York on Washington's Birthday

High-Water Street Cars Recently Used in Cincinnati

WHEN the Ohio River is on a rampage, the streets in the lower section of Cincinnati, in the levee district, are often flooded and many times traffic on the car lines has had to be stopped.

To remedy this condition the engineering department of the traction company devised the high-water cars shown in the accompanying illustrations. The car bodies are placed upon trestles resting upon the wheel trucks, so that the floors of the cars are about five feet above the level of the street. The front car furnishes the power with its motors up high and dry and communicates it to the car wheels by means of sprocket chains. The trailers are similarly raised and three steps give access to them. These cars are capable of making their way through water of a depth of five and a half feet and are giving great satisfaction.

Cincinnati's high-water cars, specially designed so that car and running gear are all out of the water. The cars can run in five-and-a-half feet of water and operate in flood-time

This remarkable picture, which looks so much like a glorious sunset or cloud effect, is in reality a great pile of coal in flames at Superior, Wis. It was finally put out with bicarbonate of soda

Extinguishing Fires in Coal Piles with Bicarbonate of Soda

IT has long been known that as the result of spontaneous combustion fires often originate in the interior of large coal piles, especially when the coal is fine and contains a large percentage of sulphur. Some of the recent coal-pile fires have demonstrated, however, that under favorable conditions spontaneous combustion is liable to take place even in piles composed of coal in large lumps. It depends principally upon the nature of the coal and upon the amount of rain to which the pile is exposed.

John A. Thomas, of Columbus, O., who made a special study of spontaneous combustion, is the originator of a simple and effective method of extinguishing such coal fires. The application of his method has prevented enormous damage in several instances, where fire had originated in large accumulations of coal.

Mr. Thomas uses a strong solution of bicarbonate of soda, which he throws upon the burning coal-pile by means of a force pump. The carbon dioxide, released from the soda puts out the fire. The gas is assisted by the water which, by the heat of the burning coal, is transformed into steam.

The illustration shows the burning coal-pile at Superior, Wis. A considerable part of the 100,000 tons comprising this pile was saved by Mr. Thomas, after the fire had been raging more than three weeks in the interior of the pile.

Why It Is That Bricks Are Made with Straw

EVERYONE is familiar with the story of how Pharoah commanded his taskmakers to increase the burdens laid on the Israelites by withholding from them the straw wherewith to make bricks; and doubtless many have wondered wherein the hardship lay. By most people, probably, the view has been held that the straw was added as a binding material, much as hair is used in mortar; but such an explanation is scarcely satisfying when it is remembered that the straw fiber is a very weak one. Alexander Findlay says in his "Chemistry in the Service of Man" (Longmans, Green and Co.):

"About fourteen years ago it was found by Dr. E. G. Acheson, to whom we owe the discovery of carborundum and the process of making artificial graphite, that when clay is mixed with a dilute solution of tannin, it becomes much more plastic, and the strength of the dried brick is, moreover, greatly increased. Although straw does not contain tannin, it was found that when straw is treated with water, the extract obtained has the same action on clay as tannin has, the plasticity of the clay and the hardness of the brick being greatly increased."

Shooting a hawk from a motorcycle while riding at forty-five miles an hour. A highly successful method of killing birds, employed by an enterprising Los Angeles taxidermist

Shooting Hawks from a Fast Motorcycle While Traveling at Speed

EVERETT COLBURN, a Los Angeles taxidermist, has evolved a new method of hunting hawks and other birds of prey which is spectacular and hazardous, but nevertheless efficient.

Mr. Colburn, who is also a motorcyclist, noticed that often when he was touring over the country highways, hawks would frequently sit on telegraph or fence posts at the side of the road and allow him to pass on his machine. They had come to regard the machine as a harmless thing. So, by way of experiment, he constructed a bracket on the top of the gasoline tank of his machine for carrying a shotgun. Then he [illegible] the [illegible] what [illegible] [illegible]

The Windows Fold Back Out of the Way and Let in the Air

A NEW type of casement window, shown on the house in the accompanying illustration, overcomes several of the ills that casements are heir to. While the windows are held rigidly at both the top and the bottom, they may be easily moved from side to side. When shut they make a tight, weather-proof joint. Thus there is an unobstructed opening when the windows are opened and a real window when they are closed.

[illegible] casement window is weather-tight and [illegible] to open and close. It does not rattle

Almost any style of finish that is possible with other windows may be used, including the division of the sash into small panes or fitting with art glass. Sliding screens placed on the inside next to the screens are used; the shades and draperies are placed inside the screens. This allows the adjustment of the shades without opening the screens, and also prevents the shades and draperies from being blown outside when the window is open.

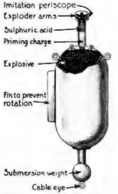
A Floating Invitation to Suicide

It's a mine with an imitation periscope projecting from the water

"PERISCOPE in sight!" calls one of the lookouts on the starboard side, excitedly pointing to a small object a few hundred yards away, which his keen and well-trained eye has just discerned. A dozen glasses are trained upon that object a moment later and as many observers, firmly convinced by what they see, that they have the periscope of a hostile submarine before them, begin to fidget in anticipation of the coming events. The first impulse of the officers of the ship is to head straight for the periscope and to ram the submarine to which it belongs.


Ships will do well to steer clear of this imitation of a periscope; to ram it means exit

The captain, knowing that in the early months of the war eighty British ships were sunk because their impetuous commanders thought that periscopes are always associated with submarines, does not yield to the rash impulse of his officers, but decides to try a shot at the periscope first. The second shot hits it squarely and there is a terrific explosion.



Charged with T. N. T., wet gun-cotton or dynamite

It was a mine—not a submarine—a mine, equipped with a seductive imitation of a periscope designed to lure on overbold vessels. An attempt to ram the supposed submarine would have been fatal to the ship. The mine is the invention of a foreign officer now working for the United States Government and proved to be highly effective in the early part of the war, until the commanders of vessels had learned to curb their impetuous impulse to ram everything that looked like a periscope.

A large metal cylinder holds a firing charge of five hundred pounds of tri-nitrotoluol, wet guncotton or dynamite. Bolted to the lower end of the cylinder is a weight to keep the mine upright and so far submerged that only the tubular firing device, simulating a periscope, shows above the surface. The trigger ends are in the top of the periscope-like device. The trigger is so arranged that any pressure upon it causes it to break a bottle filled with sulphuric acid. The acid sets off the priming charge in the lower part of the tube, and this causes the explosion of the main charge of the mine. Of great importance is the vertical fin attached to the outside of the mine. It acts like the rudder of a ship and prevents the mine from spinning around under the influence of wind and wave action, which adds in a large measure to the value of the invention.

The seat gives the baby just the right height for comfort at the dinner table

This shows the construction of the seat, which may be compactly folded up

How to Change an Ordinary Chair Into a High Chair for Baby

L. FARRER, of Welland, Ont., had three little children of high-chair age in his family, but only one high chair. This set Mr. Farrer thinking and eventually the idea of constructing a contrivance for temporarily changing a low into a high chair took definite form in his mind. After a number of disappointing attempts he evolved the invention pictured.

The contrivance consists of a wooden seat which can be attached to the back of an ordinary chair by hooking the heavy wire connected with each folding armrest over the back. By turning the spiral of the hooking arrangement the height of the seat can be adjusted to the requirements of the child using it. When the seat is not in use it can be folded up so as to take but little space.

Feeding and Watering the Chickens Automatically

DON'T scatter chicken feed by hand. It is a waste of time nowadays. Nikilas Lappas, of Salem, Massachusetts, has patented a machine which does the work and never forgets. At regular intervals his apparatus delivers measured quantities of water and feed for poultry without the aid of a human hand.

The barrel shown in the accompanying picture contains water which drips from the spout very slowly into the tilting bucket below. A suitable valve regulates the rate at which the water drips into the bucket. It takes eight hours for the bucket to fill. When full it tilts and dumps the water into a trough. From the trough the water flows to a basin, from which the chickens drink. Attached to the weight suspended from the tilting bucket are bells which jingle as the bucket is overturned and remind the chickens that meal time has come, quite in the best boarding-house style. The feed is likewise supplied at regular intervals automatically, from the large can which surmounts the apparatus. It flows through a spout into the hopper, and thence on to a curved delivery plate which scatters it in all directions just as if it were thrown out by hand.

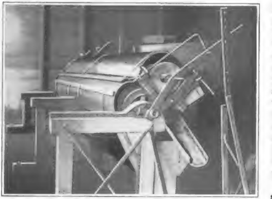
The tilting of the water bucket when it is emptied supplies the motive power for operating the device and once started it requires no attention.

Here is chicken-feeding reduced to a system. Water and feed are automatically dealt out

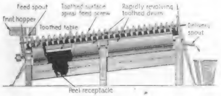
Even Fruit Skins Are Utilized Now. This Machine Does It

An apparatus which will dexterously peel everything from limes to large grapefruits (the first stage in the extraction of useful oils from the peels) has been developed by the experts of the Department of Agriculture. With a battery of these machines placed in a factory, many thousands of dollars worth of by-products can be utilized.

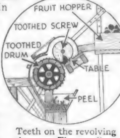
Unlike other peeling machines, the fruit does not have to be sorted to fit into the gratings. Fruit of all sizes and shapes tumbles down through an opening in the storage box on the top of the apparatus and falls in between the flights at the end of a long horizontal screw. This screw is revolved by a motor with the result that the teeth, projecting from both sides of the screw flights, take hold of the material and turn it around against a drum which is rotating in the opposite direction.



Fruit of all sizes and shapes tumbles down through an opening in contact with a motor-revolved screw



The drum is also provided with short teeth. The teeth of the screw and those of the drum, working in opposite directions on the fruit, grate the skins off. As the screw tends to turn the fruit around, it also pushes the fruit forward over the length of the drum. The peels are thus made to come off in spirals. The peelings fall into a trough at the bottom of the machine and the fruit pulps are dropped out on a chute at the side.



Teeth on the revolving drum. The peelings come off in spirals

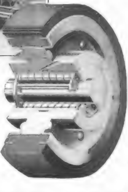
Them There Pesky Tobacco-Chewin' Bugs Ag'in

While tobacco is recognized as a valuable insecticide which will kill most insects, there is at least one that lives in it and on it and thrives exceedingly—far too exceedingly, to be pleasant. This tobacco beetle, as he is called, is very epicurean in his tastes and prefers the better brands of tobacco. He is a native of Cuba and the Philippines, but has spread all over the world. He only lives in manufactured and stored tobacco, never in the growing plant.

There are several other insects that prey on the tobacco beetle, and his destructive larvae, but it is none the less necessary to control him by artificial means. Extremes of heat and cold will eradicate him, and fumigation with hydrocyanic acid or carbon bisulphide is also very effective in compassing his destruction.

The process of manufacture usually does away with both beetles and eggs, so that if protective measures are adopted their ravages can be more or less obviated. The smoker, therefore, has no well grounded reason to feel concerned regarding the possibility of finding the beetle in his cigar or cigarette. And the fact that the insect prefers expensive tobacco to the poorer grades may prove consoling to him who can afford only cheap "smokes."

The canvas tire is less destructive to concrete factory floors, linoleum runways, etc., and is practically noiseless



This improved tire is made up of layers of canvas bound together, and may be fitted with a roller bearing as shown

Canvas Wheels Reduce Noise and Save Floors

WE have steel tires, pneumatic tires and solid rubber tires, each with its place on some sort of vehicle, but the latest is a canvas tire designed for factory trucks, hand trucks, electric industrial vehicles and other portable objects such as hospital beds, operating tables, oil and gasoline tanks and a score of other devices. Less resilient and less costly than rubber, the canvas tire is far more resilient than iron or steel and of equal wearing qualities.

The canvas tire finds its greatest field on vehicles which are either slow or which do not travel far. It is far less destructive to concrete factory floors, linoleum runways, etc., than metal tires and does not wear away concrete and produce the fine dust which is so destructive in some forms of manufacture. The canvas tire is practically noiseless, which means greater comfort in cases of hospitals and the like and greater production in factories by the decrease of distracting noises. It is not affected by water, oil or grease and as a result is used on kitchen, laundry and packing-house equipment.

Tire Repairing Made Easy with a New Spreader

AN accessory designed to make easier and lighter the work of repairing automobile tires has recently been put on the market. It consists essentially of two parts—a buffer plate and a working stand on which the tire cover is held. The buffer plate, which is convex, is applied to the outside of the cover at the place where it is desired to make the repair, and is held in place by a clamp. Thus the cover is pulled back and the operator is able to reach the canvas. The cover is then placed on the stand, as shown in our illustration, with the buffer plate next the stand. It is held in place by two claws that engage the beads of the cover and hold it firmly. The stand has four small rollers on its saddle which can be raised to bear the weight of the cover, enabling it to be easily rotated for examination, or which can be retracted level with the saddle while the cover is being worked on. The machine weighs about sixty pounds. The fabric can be cleaned with a buffer wheel in a very short time, instead of by the old laborious method of scrubbing with gasoline.

The work of Automobile tire repairing is made easy with this machine

School Trains Women for Railroad Service

Some Wonderful Changes Wrought by the Draft

THE war has created in all belligerent countries a scarcity of male workers in occupations which heretofore have been considered unsuitable for women. Thousands of the young men employed in the shops and factories, the offices, yards and round houses of the various railroad lines of the country have been drafted into the army or navy and many thousands more are sure to be drafted if the war should continue for a long time. The railroads, being conducted upon a strict business basis, never employed more men than were absolutely necessary for maintaining the efficiency of the service. To prevent the service from being crippled, the vacancies must be filled with other efficient workers.

Realizing that the supply of available men is greatly limited, some of the large railroads took steps to train women to take the places of the men drafted into military service. Since many branches of the railroad service, like the telegraphic and telephonic service, the block-signal operating, etc., demand a certain amount of previous training and experience, some of the large railroad companies established schools for the systematic training of young women for these branches of service. The students are taught telegraphy and in six to eight months most of them develop into skilful and rapid senders and receivers of telegraphic messages. They are also instructed in the manner of controlling the block signal system by telegraph and telephone. The instruction is along practical lines and is aided by models of railroad tracks with block signals, switches, trains, etc.

Studying the movement of trains by means of realistic models. Below: Part of the room in which girls are preparing themselves to become railroad telegraphers and train operators

The diagram on the sugar-bowl represents the comparative total consumption of sugar of the eight countries mentioned

Our War Sugar Bowl

Sugar is a quick-action food, and that is why armies must have it to restore energy

By John Walker Harrington

SWEETS are the true food for fighting men, as sugar is almost instantly converted into heat and energy. It is pure fuel for the human furnace and it burns without ashes. Mosso, the distinguished Italian physiological chemist, through experiments in Naples many years ago, proved this with the ergograph, a contrivance which measures the fatigue that ensues when the hand is opened and shut, for example. He demonstrated that from three to five ounces of sugar eaten in the afternoon between the hours of five and seven o'clock restored the vitality which lags always at that period of the day and practically started the human machine going with the same force which it had in the early morning.

The German Army Fights with Sugar as Well as with Bullets

Germans, always on the alert to utilize the discoveries of science, have, in effect, claimed the work of Mosso as their own and put it into practical application at their army maneuvers. Soldiers under special rations of sugar withstood the hardship of forced marches much better than did those who had none or even a normal amount.

With the declaration of war, the amount of sugar consumed by each person in Germany rapidly increased, and the army got most of it. In the meantime, the vast beet fields of France and Belgium had been devastated, and the whole cane sugar trade which had been supplying Great Britain with such enormous quantities was much disturbed. Of the 18,000,000 tons of sugar which the world produces a little more than half is cane and the balance beet. In making estimates the sugar derived from the maple tree and other insignificant sources is not considered.

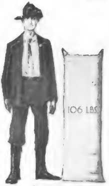
Australians Have the Sweetest Tooth of All

Although the United States is outstripped in both beet and cane growing by six nations, she leads in the world's sugar marts. We consume nearly 4,000,000 tons a year and each person eats an annual allowance of 86 pounds, according to the returns for 1917. Although the American sugar barrel demands the most, the American sugar bowl, that is, the amount eaten by each person, is not so large as in some countries. The less sugar a nation produces, the more, relatively, it is likely to eat. The Australians have the most eager sweet tooth, for each one of them in twelve months consumes 106 pounds.

Denmark, which is small in population, suddenly rose to a per capita consumption of 93.48 pounds a year in 1914-15, an excess which perhaps her Teuton neighbors can explain. The United Kingdom, that is England, Ireland and Wales, is credited in that period with an annual per capita consumption of 89.49 pounds, while for the same season every American was eating sugar at the rate of 84.40 pounds a year. The Germans had been having before 1914 forty pounds a year each. Owing largely to needs of the army and also to the fact that the Teuton countries which had been ex-

porting large quantities of sugar began to eat the surplus to make up for the deficiency of other foods, they soon reached a per capita consumption of 74.95 pounds.

All these orders for quick-action food brought in sight the bottoms of sugar bowls and barrels all over the world. Germany is getting a very scant ration of sugar at present. The government of France has decreed that twelve pounds a year is quite enough for each of her inhabitants, and similarly the United Kingdom family supply has been cut to 36 pounds a year for each person.



AUSTRALIA

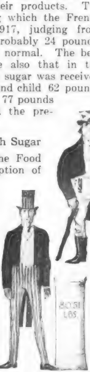
DENMARK

These figures do not, however, include the amount of sugar which confectioners and bakers and manufacturers work into their products. The actual amount of sweetening which the French individual assimilated in 1917, judging from certain export figures, was probably 24 pounds, which was slightly less than normal. The best obtainable statistics indicate also that in the United Kingdom enough raw sugar was received to give every man, woman and child 62 pounds in 1917 as compared with the 77 pounds of refined sugar assimilated the previous year.

America Is Not Saving Much Sugar

Despite the cautions of the Food Administration, the consumption of sugar in the United States has not decreased very much, considering the fact that candies, desserts and various other edibles are being used more than sugar in the concentrated forms. The exportation of condensed milk and canned fruits has also somewhat augmented the American use of sugar. Another factor in the six pounds per capita increase in consumption in 1917 as compared with 1916 has been the curtailing of the liquor traffic. Even before the war, sugar was having an increasing vogue as a substitute for alcohol.

UNITED KINGDOM



UNITED STATES

GERMANY

FRANCE

In some phases, the present sugar shortage is a blessing in disguise. The recent investigations of Professors Sherman and Swartz in the laboratories of Teachers College, Columbia University, show that we are inclined to eat more free or uncombined sugar than we should. Four to five ounces a day, which is about our present consumption in all forms, is considered a healthful ration. It is best to eat sugar in made dishes or conserves, so that it may be somewhat diluted and therefore more digestible.

Much sugar can be provided for our fighters, if we eat more sweet fruits and vegetables, as well as of that alluring though often cloying honey, which satisfied a saccharine craving long before the Crusaders brought from the Orient the magic crystal of the succulent cane. In addition to hone we have as sweeteners maple syrup and corn syrup, which w both answer many purposes for which we now use sugar, a often quite as satisfactorily.

The "Fulton Market" Hair Cut in Your Own Home

HAVE you ever heard of the "Fulton Market" hair cut? After the barber has trimmed your back hair as closely as he can with the shears, he strops his razor and proceeds to shave your neck, as if he suspected you of a desire to grow whiskers where they ought not to be. The result is so pleasing to the eye of the New York 'longshoreman and the Western cow-puncher that the shaved neck has its vogue among those who hold Fifth Avenue and its foppish ways in contempt. Even if you survive the loss of blood caused by incidental gashes you may be temporarily or permanently disfigured. The artistic success also is questionable.


No danger in shaving your neck with this well-contrived device

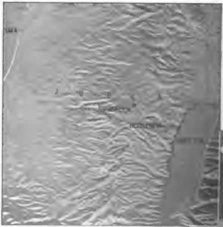
To supply the wants of neck-shavers, Mr. William C. Bridges of Muscatine, Ia., has invented a device to make shaving one's own neck a harmless operation. An adjustable band which encircles the head is connected by a curved and rigid finger extension with the guard proper. This protective part of the device consists of an adjustable arrangement of curved strips of metal or some other material, held together by pins moving in slots. To give the guard a firmer support it is supplied at its ends with ear rests covered with rubber sheaths.

A Maker of Relief Maps Who Has Few Competitors

THERE are only a few men in this country who devote their time to the making of relief maps. One of the most noted makers of such maps is Fred Burgie, a French Swiss, who learned the art from his father, Professor Joseph Burgie, formerly a famous European maker of relief maps.

More than forty years ago, Prof. Burgie, accompanied by his son, Fred, went to Palestine and made a careful survey of the Holy Land. He gathered valuable data concerning many points of importance in history and tradition and used them after his return, when he made a relief map of Palestine.

Fred Burgie followed in his father's footsteps and became the most renowned maker of relief maps in the United States. In his little shop in Rochester, N. Y., he has made a large map of Palestine, now at Crystal Palace, London, and a smaller replica of that map for the National Museum in Washington.


Photograph of a section of the Palestine relief map modeled by Mr. Burgie, for Crystal Palace, London


Fred Burgie, at work on a map at his shop in Rochester, N. Y., He is an expert in this work

Bacteria Cannot Live in the Light

IF we cover with black paper one-half of a petri dish (a small circular glass tray with cover) in which bacteria are growing and then place the dish in a light warm place for a few days, the growth of bacteria in the light part of the dish will be found to be checked, while growth continues in the covered part. It is a matter of common knowledge that disease germs thrive where dirt and darkness exist and are killed by any long exposure to sunlight. According to George W. Hunter's "Civic Biology" (American Book Company) this shows us the need of light in our homes, especially in our bedrooms.

© Western Newspaper Union

This living emblem of the Marine Corps is formed of its bearers in their parade ground at Paris Island, S. C.

Underfeed Pipe That Loads from the Bottom

THE accumulation of moisture laden tobacco in the bottom of the bowl of the pipe is unknown in a style that is fed from the bottom. When more tobacco is to be put into the pipe, the bottom is removed, the new tobacco inserted from below, and the bottom replaced; consequently no part remains for days to soak up moisture and juices. The removal of the bottom also facilitates the cleaning of the pipe.

Whether or not one would appreciate the aroma of tobacco that would permeate his clothes as a result of carrying around the dottle in his pipe between smokes, is another matter.

Those who usually accumulate a lot of moisture in their pipes when smoking will find this new fangled pipe a great boon.

Section and method of loading the bottom-filling pipe

Two Thousand United States Marines Form Their Emblem

TWO thousand marines, quartered at the training station of the U. S. Marine Corps, at Paris Island, S. C., are shown in the accompanying picture grouped in such a way as to form the design of the service emblem of the Marine Corps, a globe showing the western hemisphere, an American eagle perched on top and an anchor crossing it. It is well to remember the fact, that in the emblem North and South America are visible on the surface of the globe. Otherwise it would be rather difficult correctly to interpret the meaning of the dark spot within the circle representing the globe.

The novel grouping of masses for pictorial effect is not an easy matter and it must have required a great deal of patience to obtain the strikingly good effect shown by the photograph, which was taken on the parade grounds of the training station.

What a $50 Liberty Bond Will Buy

The War Department spends $4,875,000 a month to turn out rifles of the type which this soldier is holding ready for the attack

Here's another use for Liberty Bond money. Gas masks, like that shown in this photograph, cost $339,000 for the men of one division of infantry. But that's only one item of one nation. Almost a dozen cities larger than New York could be bought with the money spent on the war by the various governments

Look at these articles of wearing apparel and then [illegible] this: The expen[illegible] of clothing a [illegible] lion and [illegible] Americ[illegible] [illegible]

What a $50 Liberty Bond Will Buy

Steel helmets can be supplied to one division for $84,000. Helmets of the type pictured here will save the American troops from death or wounds. The rifle recalls the words of General Percin of France, who said, basing his statement on the cost of the war to his country up to January 31, 1917, that it cost $32,000 to kill a man

To equip three brigades with the kind of shoes worn by this defender of the nation means an outlay of $285,600. The cost of each pair is $5.10 and it takes nine pairs a year per American soldier abroad, allowing for consumption and proper reserve supplies. So less than a $50 Liberty bond will keep a man shod for twelve months

Giant Cars to Help in Solving the Coal Problem

ONE of the reasons given for the coal shortage during the past winter was the lack of transportation facilities.

The coal-carrying railroads of the country have tried for some time to solve this serious problem by substituting larger cars for the old style coal cars of limited capacity. One of the southern railroads is now trying out several gigantic coal cars, which hold the record as the largest of their kind in the world. The average coal car in use on the different railroad lines has a capacity of sixty tons, while the new cars, one of which is shown in the illustration, has a capacity of 120 tons. The new cars, which differ materially in their construction from the old style cars, are only fifty feet long, that is fifteen feet longer than the average coal car of steel construction. The greater capacity has been attained by increasing the length of the car and also its depth. The center sill running lengthwise through the car acts only as the medium for transmitting the pulling and buffing stresses, while the side framework resting upon the trucks carries the load. To obtain a better distribution of the weight, six-wheel trucks are used instead of the usual ...

If You Own a Walnut Tree These Days You're in Luck

WALNUT, walnut, walnut. That is what your Uncle Sam is looking for just at present. What does he want it for? Why gunstocks. Walnut is and always has been the wood *par excellence* for the manufacture of stocks. It is easy to work, will not easily crack, and will not splinter.

In spite of the enormous demand which has always existed, and exists now more than ever, there is any amount of the wood to be got, so long as you are willing to pay the price. The reason for this is that in the timber countries, as they have become more and more settled, the inhabitants have sought to beautify their land and homes, and consequently, lacking the urging of necessity, have absolutely refused to sell their trees at any price. Now, under the spirit of patriotism, people are sacrificing these grand old landmarks to the service of their country, and consequently the Government is getting all the walnut it needs.

The boys are getting first-class stuff too. Uncle Sam lays down standards and when he's laid them down he sticks to them like glue. The consequence is that in this case the stocks are all cut from good wood, properly selected and seasoned, and with the grain running the proper way to guarantee the requisite strength.

The next best wood for gun stocks is oak. Oak, however, does not yield so readily to the turning of the lathe. Furthermore, walnut will not ... readily as ... woods ...ble.

...al-car but has a capacity of one
...rious transportation problem

Carelessness and What It Means in Forest Fires

DURING the year 1917 our National forests were devastated by 7,814 forest fires. According to the report of the Forest Service of the Department of Agriculture all these destructive fires, with the exception of 2,132, which were caused by lightning, could have been prevented; 952 were undoubtedly incendiary fires, while the rest were due to pure carelessness of campers, hunters, railroads, settlers or travelers.

Applying the Fireless Cooker Principle to the Delivery Wagon

EVERYONE, nowadays, knows the principle of the fireless cooker. Interpose a sufficient layer of insulating material between the atmosphere and the food which is to be kept hot and you reduce the amount of heat radiated. The principle is also applied in keeping chilled food cold. The insulating material used is mixed wool, asbestos, or even hay.

The same principle has now been successfully applied to delivery trucks and packing boxes. One of the large express companies has been making experiments this winter in St. Paul, where the temperature was way below zero. Cut flowers, and other very delicate goods, were loaded directly from trains into these cold-proof boxes, and preserved until they could be delivered, in spite of the severe cold. Motor-trucks and wagons were also successfully equipped in this manner, insulated with paper, canvas and felt.

...ivery wagons are made on the fireless cooker ... with non-conducting walls, bottoms and roofs

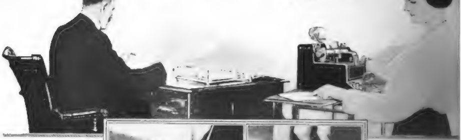
This model "patient" is for the training of dental students at Iowa

Dental Practice on Teeth That Never Ache

BEFORE dental students are permitted to practice upon patients in the clinic they must undergo a thorough training in the science and technique of dentistry at their college. In order to give a dental student the experience of working upon a model closely resembling human jaws and under conditions such as would confront him in his work at the clinic, Dr. F. H. Volland of Iowa City, Ia., has invented the device shown in the accompanying illustration.

The model jaws, with bone teeth imbedded in the gums, are fastened to an adjustable arm supported by a pedestal. These jaws may be placed in any position which the jaws of a patient in the dental chair might possibly assume. Not until the student has learned the technique of filling teeth, capping or crowning them and doing bridge work on this model will he be permitted to try his skill upon the patients in the clinic. The University of Iowa uses the model with success.

Conveniences and Novelties in Office Equipment



A new and distinctive article for the desk of the office man is the plate glass tray, the parts of which are held together with nickeled clamps

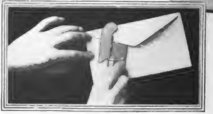
A combined adding and recording machine with movable carriage and rack attached to indicate the position of the carriage

An inkwell that tilts forward and has an automatic closing device that prevents the fluid from evaporating

An attached clip enables the pencil to be easily carried and the cap embodies a serviceable sharpener

A railroad office has this revolving table installed in one of its offices to speed up the sorting

The hand-operated envelope sealer shown below will seal fifty envelopes per minute



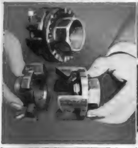
An electrically heated device that drops wax and seals packages at a much more rapid rate than by methods formerly employed

A knock-down chair that is fastened together by means of metal bolts and clips at the joints

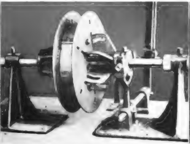
Do It with Tools and Machines and Save Time and Muscle

At the left, a two-part heat-treated steel shell shaped like a truncated cone for dressing valves

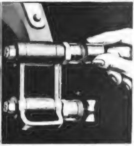
A small electrically-driven bench planer is at the right. It is adapted to home or workshop use



A boltless flange union for pipe lines, which draws the parts together by rotation

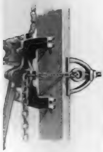


Increasing or diminishing the diameter of the pulley over which a flat belt runs by moving the vanes in or out to change speed of the shaft

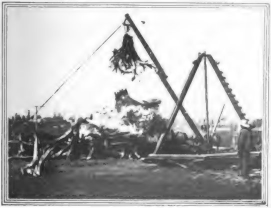


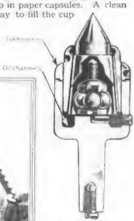
A grease cup using grease put up in paper capsules. A clean way to fill the cup

Below is shown a novel machine designed by a farmer to pile stumps for burning in land-clearing operations



A portable chain grip vise which can be fastened quickly to any kind of horizontal or vertical support. It can be used in various ways





A ball bearing lathe center designed especially for lathe used by metal spinners or wood turners

© Int. Film Serv.
This mass of debris is the result of a huge chimney crashing through factory roof

Chimney Crashes Through Three Floors of a Factory

WEAKENED by a terrific gale, a three by four-foot brick chimney towering above the roof of a box factory at Lynn, Mass., suddenly fell and crashed through three floors of the building, killing three of the employees and injuring others. Several persons were carried down with the falling brick and timber to the floors below. Others sitting quietly at work suddenly saw a great hole open before their eyes, into which their companions and machines vanished.

There were many narrow escapes from injury and death, and amid the excitement men had to be restrained from jumping from windows. Firemen, police and physicians came promptly to the scene and did heroic work. It was fortunate that no fire occured, since the stiff gale from the harbor would have spread the flames rapidly.

One of the suggestions resulting from the catastrophe is that there should be a physicians' call sounded through the fire-alarm system in an emergency of this character. A pre-arranged signal, it is thought, would bring a corps of doctors quickly to the scene and hasten the rescue and relief work.

This is really a most serious question. Everybody has read of the dreadful holocausts that happen every now and then in different parts of the country. How often it goes like this: "Several physicians were soon on the spot and worked heroically at their work of mercy until far into the night. It was pitiful to hear the groans of the injured who could not be aided immediately owing to the few doctors who were available to carry on the work."

Are You Stifling Your Feet? Let Them Breathe

SUPPLY air to the feet and foot ills would vanish is the belief of a New Jersey manufacturing company. To prove its point it has introduced a little device to ventilate your shoes. The device was invented by Mr. E. J. Devlin of Newark, and consists of a little perforated button which is made so that it will clip into a hole in the instep of the shoe like an eyelet. Into this screws a plug with a hole through the middle. By adjusting the plug a greater or less quantity of air can be admitted, but at the same time water and dust are excluded. Air is drawn in and expelled at every step. The exterior portions of the device are colored to match the shoe.

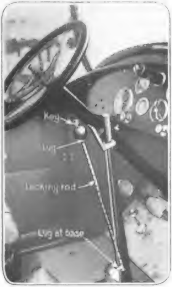
Air expelled through this shoe ventilator blows out lighted match

Highways and Automobiles in Warfare

IN discussing the importance of good highways and of automobiles in modern warfare, Major Amos A. Fries, Corps of Engineers, U. S. Army, brought out some interesting facts. Basing his statements upon the experiences of the French military authorities, he expresses the belief that in case of an emergency it would be possible within a few days to get together 200,000 automobiles, which would be able to carry 600,000 to 800,000 men with their equipment and rations to any desired place.

Locking Gear Lever in Neutral Position to Prevent Theft

ONE of the latest of the locking devices which is to be attached to an automobile, which will prevent the car from being run under its own power but which will not prevent its being stolen by the towing method, consists of a small lever-type lock inserted in the ball-ended handle of the gear-shifting lever. A key inserted in the lock operates a small rod extending down through the hollow lever to the base. The turning of the key in the lock trips a small lug on the upper end of the rod so as to rotate the rod slightly and cause a similar lug on the bottom to slip into a notch and lock the gear-changing mechanism in a neutral position. As we said above, this does not prevent a car from being towed away by a thief.



Gear-shift lever locked in neutral, preventing car being stolen

Not particularly comfortable for the patient, but it will at least take him to the hospital with very desirable speed

A Queer Improvised Ambulance In Use in France

IN addition to the large number of regular ambulances, constructed for that purpose, which are in use behind the West Front in Flanders, there are many that were improvised with more or less success from vehicles of every kind. The accompanying picture shows one of these ambulances, improvised from an automobile of the coupé style.

The bed intended to receive the patient is placed immediately behind the cab of the coupé and rests upon the box containing the gasoline tank. A trip in this ambulance is probably rather hard on the patient, but in emergency cases the conveyance may do excellent service, especially if the roads are not in too bad a condition. At any rate, men suffering from wounded limbs could be transported.

Wind, Weather and the Airman

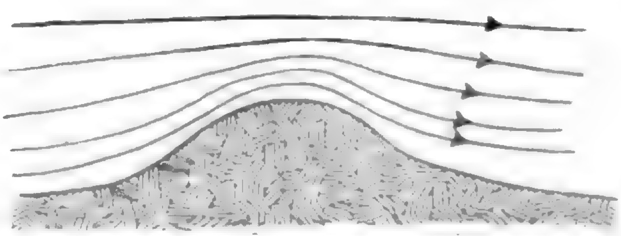
The Invisible Perils of the Whirlpools, Gusts, and Eddies of the Ocean in which Men Fly

AIR navigation, in its relation to weather, is repeating the history of marine navigation. The slow sailing-ships of early days were the sport of wind and waves; the great ocean liner of today pursues the even tenor of its way regardless of the elements. Under the urge of necessity the military aviator now flies in all kinds of weather, and his high-powered machine negotiates atmospheric difficulties that would have been insuperable a few years ago. Nevertheless, even the biggest ocean liners sometimes come to grief, and the day is still distant when the aviator will not need to keep his weather-eye wide open.

Airships and airplanes are the submarines of the atmosphere, but the element in which they ply is far more fickle than the ocean. The currents of the latter are comparatively feeble and regular; those of the former are often immensely powerful and capricious.

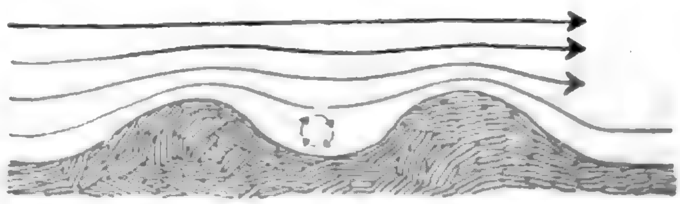
There Are Winds and Winds

An aviator studying the atmosphere learns much of interest. The structure of the atmosphere with respect to wind is a subject concerning which a great fund of knowledge has recently been acquired through the practical experience of aeronauts on the one hand, and the scientific investigations of meteorologists on the other. The mariner dreads a strong wind; the aeronaut an unsteady one. Mere strength of wind is harmless to the aviator, except in starting and landing, and, indirectly, owing to its ability to drive the airplane far out of its intended course. If the strongest hurricane that ever blew were perfectly steady, the airman might well be as indifferent to its speed as the average mortal is to the speed with which our terrestrial globe rotates on its axis. But unfortunately the wind is hardly ever steady, either in force or direction. It is full of gusts and eddies, up-currents and down-currents, and it is these eccentricities which gradually develop in the aviator a sort of sixth sense, a "feel" for atmospheric fluctuations, that enables him to adjust his machine instinctively to the forces tending to disturb its equilibrium. He also learns by experience the conditions under which irregularities of a pronounced character may be expected. He becomes well acquainted with the great mound of air that drives the airplane upward in passing over a hill or mountain; with



Flow of Air Over a Ridge

Notice that the crest of the air wave lies a little beyond the crest of the ridge. This does not apply to isolated hills, which the air easily passes around



Flow of Air Over Two Ridges

Notice the eddy in the valley to the leeward of the first ridge. In this case the crest of the air wave still lies beyond the crest of the ridge, as seen above

A "Sheltered" Landing-Place May Be Dangerous

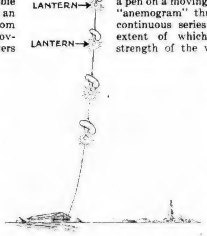
A landing-place surrounded by trees is dangerous in windy weather on account of the air waves between the moving air above and the calm air below

Waves and Gusts in the Air

The illustration shows how these are made visible by smoke. The reader will be able to observe this phenomenon for himself almost any windy day

the eddy that lurks in the lee of such an obstacle; with the downward tendency of the air over lakes, rivers, swamps and forests. "The air is so sensitive," said Mr. Gustav Hamel, the famous flyer, "that it is affected even by the color of large patches of vegetation. Whether this be entirely due to the different heat-radiating power of different colors, it is impossible to say, but invariably an aeroplane on passing from grass land to a field covered with yellow flowers experiences a certain amount of air disturbance only less noticeable than the inevitable bump experienced in passing from green fields to ploughed land or from ploughed land to meadow."

When the wind is blowing, the air for at least a few hundred feet above the ground is nearly always in a state of turmoil. This is partly due to friction of the moving fluid against the irregular surface of the earth, and partly to the ascending and descending currents caused by differences in temperature. The latter effect is illustrated in the rapid rise of air over a bare plain, by day, and its fall over an adjacent forest or body of water. A good picture of the atmospheric ups-and-downs and other disturbances encountered by the airman when flying low is furnished by the behavior of the smoke from a factory chimney with a moderate wind blowing, forming smoke-waves.



A Solution of the Fog Problem

Along the main flying routes landing-grounds will be established at intervals of ten miles. Their location will be marked by illuminated kite-balloons

The Autograph of a Gust

These disturbances give rise to the very marked fluctuations in the force of the wind known as *gusts*. There are certain forms of anemometer especially designed to record the gustiness of the wind. A record of its force is traced by a pen on a moving strip of paper, and the "anemogram" thus obtained shows a continuous series of irregularities, the extent of which increases with the strength of the wind. The puffs and lulls often alternate at intervals of a few seconds or less, and the actual strength of the wind at a given instant may be many times greater than its average force for, say, five minutes.

The turbulence of the lower air extends to various heights, depending upon the strength of the wind. A rough rule, evolved by Zeppelin pilots before the war, was to expect turbulent conditions up to an altitude equal to from 10 to 20 times the force of the wind in meters per second. Thus, for a wind of 10 meters per second, the turbulent layer would be from 100 to 200 meters deep, and so on accordingly.

With increased altitude the wind generally increases in both strength and steadiness, but sometimes very unsteady air is encountered even at great heights. This brings us to the important subject of air-layers, or broad streams of air

Clouds Seen from Above

Aeronauts, looking down on the wind-swept surface of the clouds have observed their surfaces to be thrown into a series of rolls of vapor, which are vast waves of air with crests half a mile apart

Air Waves Far Above the Earth

With the right conditions of temperature and humidity these waves are made visible by the formation of little clouds whose crests are marked as furrows. These are called *cirrus*, and are the light, fleecy summer clouds

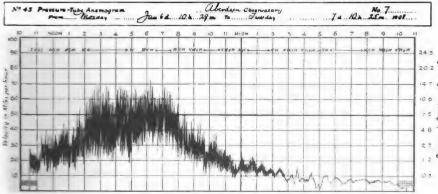
of different temperatures and humidities, which glide over each other without much intermingling. At the boundary surface between them, friction sets up waves like those produced in water by wind flowing over it. When the two streams are moving in the same direction the waves are long and regular; when they are more or less crossed, the waves are short and choppy. The moisture at the crests or furrows of these waves may be cooled to such an extent as to condense into visible clouds, arranged in long continuous rolls or successive rows of detached patches; but more often the waves are entirely invisible.

Ascending and descending currents in the air are also sometimes made visible by the larger detached clouds of the type known as *cumulus*. Each of these clouds marks the summit of an ascending column of moist air, while in the spaces between them the air is generally sinking. The upflowing air under a cumulus cloud may attain a vertical speed of 25 or 30 feet a second, while the descending current between clouds is sometimes so strong that an airplane cannot force its way up through it. The most violent vertical movements are encountered in thunderstorms. The term "hole in the air" describes a sudden downward tendency of the airplane, whether due to running into a descending current or to encountering a sudden change in wind velocity and consequent lifting force.

There has been much talk about "charting" the winds for the aviator—a project implying the assumption that the currents in the atmosphere are as regular and as constant in their location as those of the ocean, which is far from being the case. Even the most constant winds in the world—the trade winds—are subject to great fluctuations in force. What the aviator really needs to know is the typical behavior of the winds with respect to the distribution of barometric pressure at a given time (as shown on a daily weather map), and how they are likely to be affected by the topography of the country over which he is flying.

Fog—the Airman's Dread

One of the most serious weather problems of the aviator is presented by fog. When flying above a fog (and the same is true of low-lying clouds) the airman has no landmarks to guide him. His compass is almost useless, because, while it tells him which way the head of his machine is pointed, he has no means of knowing how much he is being drifted out of his course by the wind. In a long flight his "leeway" may carry him scores or hundreds of miles wide of his objective point. Fog also presents a grave danger when he is landing, as he knows neither his distance from the



The Wind's Autograph on a Gusty Day

Recorded with a pressure-tube anemometer. The vertical lines are hour-lines and the horizontal lines show the force of the wind in miles an hour and also in pounds a square foot. Direction is also indicated

ground nor the character of the latter. Many a forced landing in foggy weather has ended disastrously in the ocean.

The fog problem will undoubtedly be solved. Probably the radio-compass or some other system of wireless signalling will help the airman keep his bearings, and he will obtain further guidance from aerial buoys, in the shape of captive balloons, floating above the level of all ordinary fogs. Mr. Holt Thomas, in England, has recently proposed the plan of establishing landing grounds at intervals of a few miles along the main air routes, their location to be marked with kite-balloons by day and powerful searchlights by night. A better plan would be to fly at each landing place, and wherever else aerial signposts were desired, a string of kite-balloons flying tandem, with a lantern suspended from each balloon. It would thus be possible to attain much greater altitudes than with a single balloon and a searchlight, and hence to provide for fogs of all depths.

Little need be said about the other weather factors in aviation, because they are hardly more serious in their effects than the corresponding conditions of travel on *terra firma*. At great altitudes the air is very cold, in summer as well as winter. The carbureter must be shielded against freezing, and the aviator needs the warmest clothing. The airman also needs protection against rain and hail—the pelting of which, when one is flying at one hundred miles an hour or more, is uncomfortable, to say the least. Lightning, which is a serious hazard in ballooning, seems to be relatively harmless to the airman. Deposits of ice and snow, besides loading the planes, may hamper the working gear of the machine, though aviators have reported few cases of this kind.

Last, but not least, in the coming age of commercial aviation the weather bureau now maintained by the governments of all civilized countries will enlarge the scope of their activities so as to safeguard air traffic against atmospheric dangers; while the science of weather will, in turn, derive great benefit from the collective wisdom of practical airmen.

A Thousand Dentists Will Be in the United States Army

DENTISTS are just beginning to come into their own in the Army. Even yet their importance is insufficiently recognized. According to the latest reports we are to have only one dentist to every thousand men. Yet there are to be eight horseshoers to every hundred horses. For the two hundred and fifty thousand horses which the government will need, there will twenty thousand horseshoers, while for one million men there will be provided only a thousand dentists.

Maybe you have special needs. Write to the editor about anything within the scope of the magazine. He will be glad to help you.

Ringing the bells of St. Paul's Cathedral, in London, in honor of the great Allied victory at Cambrai

Ringing Out the Victory of Cambrai from the Great Bells of St. Paul's

NOT every one can ring the great bells in church towers. It takes skill and it takes strength. In the accompanying illustration we see the bell ringers of St. Paul's, London, preparing to ring joy bells in honor of the successful Cambrai offensive.

The upward swing of the bells is so strong that the ringers are very often pulled off their feet. On the rebound, each man lands on a small, flat cushion in front of him, by which his fall is broken. The small loops to be seen on the boxes are foot braces.

According to an old English custom, no bell ringer may wear a hat while at his work. Judging by the expressions on the faces of the men here photographed, they would uncover without any aid from precedent, for they are bringing to the occasion a deep solemnity, conscious of the cost of victory.

Campanology is one of the most interesting and most intricate arts practised. Change-ringing is exceedingly difficult and very exhausting.

When Is a Feather Not a Feather? When It's a Hair

OUR picture shows several midground types of feathers in course of evolution. They are midway between scales and feathers.

Crossing in the center are two hairlike forms called "filoplumes." Sloping up to the right is one found in abundance on poultry. It is practically a true hair with its tip divided into several slender prongs, some of which have a suggestion of feather-down near their bases. The one crossing it, noticeably more plumose, is from an owl. The form to the right with the many pointed black tip is from one of the very rare toucans. It is from midway on the neck and shows an intermediate stage between the true feathers on the back and the scalelike forms topping the head where the feathers have changed wholly into thin, horny plates or scales, seen at top of picture. Barely enough featherdown remains to suggest its origin.

To the left side of the picture is a unique intermediate stage between feather and scale—strongly suggesting a fish scale. This would be the normal trend of evolution owing to the aquatic life of the penguin from whose wing this was taken. So nearly midway between scale and feather, it claims both names and is called *squamipennis*—scale-feather.

The throat of the humming bird supplies the form at bottom. These are true feathers and take their name not from any mimetic form of structure, but from their collective appearance which is strikingly scalelike. They are called *squama*.

It is such transitory stages as this, observed repeatedly, that lend color to the evolution theory.—C. B. DAVIS.

Various peculiar types of feathers in the process of becoming scales

Cooking Your Meals While You Drive

Using the exhaust heat of your engine to prepare luncheon while running at twenty-five miles an hour

By Albert Marple

THE manifold stove is new. It fits beneath the hood over the exhaust manifold of the automobile engine and may be used for baking potatoes, heating canned goods, and water. The device costs only about a dollar to manufacture, uses heat that would otherwise be wasted and is a valuable time saver. It was invented by J. I. Wernette, of Glendale, California.

This stove is about ten inches square at the top and is fourteen inches deep. A hole cut in its side permits it to fit snugly over the manifold, and a wire netting is so arranged as to keep the pans, canned goods, etc., from touching the pipe. For baking potatoes, a baking pan, sufficiently large to fit tightly within the stove, has been provided. When warming up canned goods the cans are placed directly upon the wire netting. An especially prepared can permits the motorist to make coffee or boil water for tea.

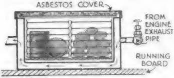
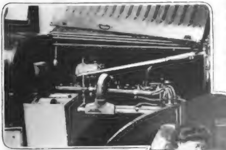


Diagram showing construction of above and disposition of the food

Another type of stove, heated by the exhaust, is located on the runningboard. This new stove is a large steel box, around the inside of which is a heating space, about one inch wide at the two sides, ends and the bottom. To provide the space a sheet-iron box is soldered in place within the steel box, the iron box being one inch smaller all around than the steel stove. The pipe which carries the exhaust gases to and through the stove is attached to the main exhaust pipe. A hole is made in the pipe and the end of the cooker pipe clamped over it. There is a valve between the exhaust pipe and the cooker so that the latter can be disconnected or used at full capacity. The gases escape eventually through an auxiliary exhaust pipe. Removable wire shelves are placed within the stove whenever it is desired to cook potatoes or apples. So efficient is this cooker that a large fish, a rabbit or quail may be cooked to a turn while the car is traveling a distance of fifty miles. Potatoes or apples may be baked in a distance of from fifteen to twenty miles. This box or stove is two feet long, ten inches wide and twelve inches deep. An asbestos pad arranged within the lid retains the heat.



Showing stove under hood with all the necessary connections to main exhaust pipe. This stove is ingenious and gives excellent results

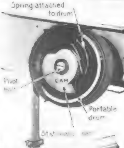
This is the footboard stove. The illustration shows the food being placed in the cooker and the valve that controls the heat

Letting Gasoline Do It

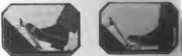
Attachments to a tractor for handling a road shovel, operated by a single person

Latticed shoe cleaner set into the automobile running board helps to keep the interior of the car in condition

Cleaning the carbon from several
material for removing the carbon is

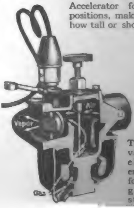


Shock absorber within a drum, attached to the frame of a car



Accelerator foot-rest that
positions, making it comfort-
how tall or short he may be

Engine piston of aluminum alloy, in skeleton form to make it light



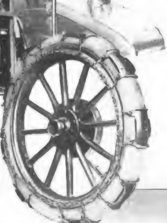
The throttle valve has an electric coil embedded in it for heating the gas to make starting easy

Letting Gasoline Do It

A tractor need not be purchased only for summer work; it may be used in winter to harvest the ice as well

automobile engines at one time. The contained in the large tank on the right

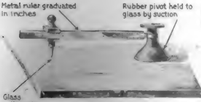
In keeping with the times this miniature airplane at the left, bearing the United States insignia, makes a neat automobile radiator ornament



Sharp spurs attached to an automobile chain to give greater grip on road

has adjustments for many able for any driver no matter or how large his foot is

How the air currents to a radiator may be controlled by the use of a curtain operated from the driver's seat, is shown below



Rubber base standard with revolving arm and cutter for making automobile headlight glasses

"Acting" the old Colonial days. Massachusetts school children learning history in a new and interesting way

How Many Cubic Feet in a Ton of Coal?

HERE is a little information which will help you to solve the vexing problem that is apt to be a hardy annual, i. e., how much coal to order in order to fill the bunkers, but without having to put some in an old barrel in the outhouse. A ton of egg coal contains from thirty-two to thirty-eight cubic feet, averaging about thirty-five. By measuring the cubical contents of your bin you will be able to estimate how much to order to fill them. This may be done by multiplying together the length, breadth and depth of your bin.

"Making Believe" You're Miles Standish to Learn American History

IN the State Normal School, situated in Salem, Massachusetts, a new method has been adopted to teach kindergarten children through pictures. Frederick W. Whitney, the art teacher in the school, conceived the idea of using drawings in colored chalk upon the blackboard to illustrate and make clearer the stories read to the children.

When he talked about the Colonial times Mr. Whitney greatly aided the interest and understanding of the children by improvising for them Colonial costumes made of cambric, pasteboard and paper. To illustrate the life of the Indians a forest scene was drawn upon the blackboard, while the children, dressed in Indian costume, were seated around the i[illegible]ry campfire.

In Trying On That New Hat You May Get Something Besides the Hat

THE doctor, who sees bacteria everywhere—even though they are invisible—warns you now against trying on hats in a hat-store.

Most men try on three or four hats before they get what they want, and it was discovered, by actual observation, that two per cent of them have noticeable eruptions on their faces and foreheads.

This paper skull cap may mean all the difference between sickness and health

As a measure of protection thin paper skull caps are recommended by Dr. Wallace A. Mannheimer. The caps are to be worn while trying on new hats.

Unfortunately, so far, it is only the better hatters that have introduced this protective measure, but it is to be hoped that the public will soon demand a skull cap as a matter of course, like an individual cup.

Grading Machine Does Work of 125 Men

It digs to grade and loads six hundred wagon loads in a day

This machine reduces road grading and the construction of good roads to an economical and scientific basis. It does the work of a large road-gang

NOT so long ago a huge machine made its appearance on a Milwaukee street which had to be graded. The machine had creeper feet in front that reminded one of the tread of a tank on the Western Front, and in the rear a roller. There was a huge wheel on its front which tore up the dirt precisely to the depth wanted—no more and no less—with the relentlessness that never could be equalled by hand shovels.

If you want to know more about the Turbine Street and Highway Grader, look at the accompanying picture. The digging is done by a rotating cylinder on which are mounted twelve buckets. Rooters on the cutting edge of the buckets lift up the dirt and tumble it back into the buckets. As the cylinder turns, the dirt is dumped on a belt-conveyor, which extends at right angles from the side of the grader and drops the material into a waiting wagon, truck or car.

Almost everything about the machine is adjustable to suit the conditions encountered. Thus the conveyor can be adjusted to load on either side of the grader. The cutting cylinder or wheel can be adjusted vertically to make it cut from one inch to two feet deep. Cuts are five feet, seven inches wide. While the digging wheel is in action, the entire machine moves forward at any of three speeds according to depth of cut and character of material which is being excavated.

The creeper tread on which the front part of the grader is supported does away with planking and prevents settling. But if settling should occur, it is easily enough detected by sighting along the grade sticks and corrected by elevating the cutting cylinder or turbine. The two sets of creeper treads have separate controls which makes it possible to make short turns when necessary.

When it is realized that the utmost capacity of hand-shovel labor is five wagons a day and that the Turbine Grader can easily load six hundred wagons and even more a day, the possibilities of the machine become apparent. It does the work of 125 men at a great saving of cost.

A New Can for Handling Gasoline to Prevent Waste

MUCH gasoline is wasted every year by evaporation and spilling. Now a Chicago firm has introduced a new can designed to prevent this waste. It is fitted with a hinged spout cover, closed by a spring. This seals the spout the moment the pressure of the thumb on the lever is released, thus preventing evaporation and also loss by splashing out or spilling. A steady stream is assured when pouring by a long pipe that extends to the bottom of the can, thus admitting air in a steady, constant stream, instead of forcing it to bubble through the stream of gasoline as it leaves the can. This does away with all the objectionable splashing when pouring out the contents of the can.

Safety gasoline can designed to prevent waste

If all the automobile owners in the United States saved one gallon a year each they would create an additional supply of 4,500,000 gallons. This is enough to keep 1,250 airplanes in fuel for a whole year. It is the team-work that will count in this as in all else. It is the "long pull, the strong pull, and all pull together."

It Walks Through the Field, and Drags a Plow

THE tractor here shown is a small, inexpensive one that can be used very profitably on farms of less than one-hundred acres. The little mechanical worker is only four feet high and three and a half feet wide, but it will plow four acres a day with a fuel consumption of less than two gallons an acre.

The tractor is the invention of Rush Hamilton, a California orchardist, who sought in vain for a machine to do his work. It may be called a walking tractor in comparison with the creeper or round-wheel types. Note the radial tread legs on the wheels. They penetrate to the sub-soil for traction.

In plowing, one wheel of the tractor follows in the furrow, thus eliminating the side-draft on both tractor and plow or other implement. The machine is so small that it can pass under the branches of trees where even a horse could not go, much less one of the cumbersome juggernauts which most tractors resemble. It also takes up very little room to store when not in use, and is simple enough to be easily repaired by an amateur mechanic.

This little tractor is only four feet high and three and a half wide, but it will do the work of four horses. It was invented by a Californian fruit rancher for his own use

How Would You Like To Be in the Place of the Man in This Picture?

THE spiderlike silhouette near the apex of the angle formed by the falling top and the majestic trunk of the magnificent Douglas fir in the center of the picture is that of a man, the logging foreman of a lumber company on Puget Sound. These giant firs are greatly needed for the keels, frames and other parts of the big wooden ships now building for the Government and are supplied almost exclusively by the forests of Washington and Oregon states.

The big tree in the picture was one hundred and eighty feet high before its top was cut off. At the point where the cut was made the trunk had a diameter of twenty-two inches. The foreman climbed the tree with telephone-linemen's spikes and fastened himself to the trunk with a lineman's belt. It took him twenty minutes to cut the top.

Cutting the top off a big fir at Puget Sound. It took twenty minutes to cut

Here Are Some War Breads You Have Never Known

OWING to the shortage of wheat the powers that be have been experimenting to see whether satisfactory bread cannot be made from other cereals. They have come to the conclusion that they can very much so.

The chief grains which the researches have added to our food-stuffs are cottonseed meal, kafir corn, feterita, grain sorghums, and milo. So far all these have been used to feed to stock, but it is found that they can all be milled and made into bread. Not only that, but the bread is more palatable and much more nutritious than wheat bread ever thought of being. For instance, cottonseed meal contains about forty-five per cent. of proteins, whereas wheat only contains about nine per cent.

Of these new grains, Kansas, Texas, and Oklahoma can supply enough to make up this year's wheat shortage, while next year, with more planted, the supply will be abundant. Texas is capable of supplying the whole country alone if necessary, so that there is no danger of a bread shortage.

The College-Trained Elephant as a Circus Attraction

"LADIES and gentlemen," begins the official barker at a side show, "it is your privilege to see before you the only living college-trained elephant in captivity, engaged at an enormous expense by the manager of this incomparable aggregation of world-famous artists and animal shows!"

With this he presents to the elephant, who looks indescribably bored, a piece of white chalk in an iron holder.

"Will some of the ladies or gentlemen kindly name some small numbers?" suavely urges the barker and from amongst the spectators come calls of "Six—Two—Five!"

The "intelligent" elephant and the way his brain works, said brain being in the head of the attendant

"Six—two—five," repeats the barker slowly and impressively and leads the graduate of the elephant college to the blackboard.

To the astonishment of the spectators the chalk traces a perfectly legible "6" upon the black surface. Underneath he writes a "2," underneath that a "5." Then comes the addition line and the result, 13.

An attendant on the other side of the blackboard did the trick. For his benefit the barker repeated the numbers so as to give him time to pick out the same numbers, cut out of sheet iron, and slip them into grooves provided for them. Then he grasped a powerful magnet and held it against the top of the six. To the same spot, on the other side, the barker directed the trunk of the elephant. The chalk holder being of [illegible] followed the magnet.

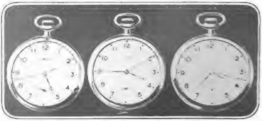
Is a Compass Necessary? Not if You Have a Watch

WERE you ever out in the "wild," carrying your map but without a compass? Your watch answers the purpose just as well.

Disregard the minute hand altogether. Then note the arc that the *hour* hand makes with the noon of the day—not the midnight—and draw an imaginary line bisecting this arc. Point this line towards the sun and the XII will point toward the *south*.

Referring to the diagrams, the first one represents 5.10 A. M. The imaginary line falls between the hour hand and the approaching noon, as shown. The second figure shows the time to be 3.45 P. M., so that the imaginary line falling between the noon and the hour hand, practically coincides with the II. In the third it is 7.20 P. M. and the bisecting line still comes between the noon and the hour hand, so that it falls between the III and the IV. The line must always *bisect* the arc, whether it is more or less than a semicircle.

One's watch makes *two* circuits while the sun makes *one*. Therefore *half* the arc between the hour hand and the nearest noon, pointed toward the sun, causes the noon—the XII—to point due south.



Dotted line in each case represents imaginary line bisecting arc between the hour hand and the noon

Here, Now, Is the "Tappoon"—a Portable Flood-Gate

UNTIL very recently it has been the practice among ranchmen when irrigating a field to dam up the ditch with mud in order to make the water flow into the lateral ditches. Howard R. Wallace, a ranchman who lives near Long Beach, California, changed all this by devising a portable irrigation flood-gate.


This is the tappoon. It is the invention of a Californian rancher and is designed to simplify irrigation

The gate is simply a sheet of heavy-gage wrought-iron—the lower corners are rounded off and a handle is bolted to its upper edge. When the gate is pressed down into the mud of a main ditch it holds the water back and diverts it into the lateral ditch immediately behind the dam. When that ditch has sufficient water the gate is pulled up and moved to the next lateral. All the work of making scores of small dams with mud is avoided.

The tappoon, as Mr. Wallace terms his device, is an inexpensive thing to make, and in the course of a California summer it saves many hours of hard labor. It is very light and can be easily carried about, and obviously has nothing to get out of order. To shift it one merely lays hold of the handles on each end and pulls it up, carrying it to the next location and pressing it in with the foot. This is one of the little things that count. It saves both time and trouble, and lightens the tedium of a thankless job.

Fish at Night with an Electric Light on Your Line

WHEN the fishing fever has fastened upon him and is at its height, the enthusiastic angler would lengthen his day, if he could, to fully forty-eight hours. One ingenious American, probably spending an all-too-short vacation in the woods, devised a plan for illuminating the end of his line and thus tempting the fish to rise even on the darkest night. In the hollow interior of his bamboo rod he placed a small electric battery of sufficient power to operate two small lamps, one attached to the rod and one to a buoy just above the baited hook. The purpose of the buoy is to prevent the lamp from being submerged. The electric wires between the end of the rod and the buoy take the place of the fishing line. The light on the buoy not only serves to attract the fish but also by its bobbing informs the angler when a fish takes the hook and is due to be hauled in.

This is an application of the old method of fishing at night with a light. The usual method, of course, is to go out on the lake in a boat, carrying with you one or two hurricane lamps. One of these you keep in the boat to see by, and the other you fasten to the gunwale so that the light will attract the fish. In this case one uses an ordinary line, of course, and trusts to pure blind luck for results.


The illuminated fishing line by means of which one can catch fish at night

Put the Tree in the Barn, Put the Cat Out, and Go to Bed

THERE'S no accounting for taste. Here is an instance where sooner than cut down a fine old tree a new barn was built around it, the trunk passing through the roof. Whether this is due to conservation or to sentiment we are not aware. It undoubtedly is a pity to cut down beautiful old trees, but just the same one would imagine that a tree in the barn would be, to say the least of it, inconvenient. Whether it is profaned inside the barn with nails and hooks and harness, who shall say? Whatever the reason, there it is, and it at least has the merit of being exceedingly picturesque in appearance and probably is unique.


They built the barn around this tree to avoid cutting it down

Ef Ye Cain't Shoot the Critters, Dynamite 'Em

A VERY simple and cheap method of destroying wood-chuck burrows has been discovered by a farmer. He takes a stick about three-quarters of an inch thick and about ten feet long, and ties a stick of dynamite to the end, ready capped and with two feet of fuse. He lights the fuse and pushes the charge into the hole. As the fuse takes about a minute to burn down, he has plenty of time to tamp the earth around it and get out of the way.

The explosion of the dynamite destroys the den and, the fumes being very poisonous, any animals which may escape the explosion are asphyxiated.

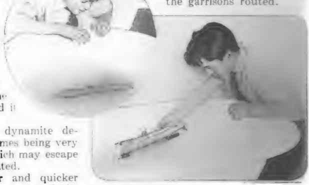
This is a far simpler and quicker method than digging them out, and the explosion fills up the burrow too.

The Battle of the Bath-Tub Fought with Toy Submarines

A TOY submarine that really runs under water has been recently put on the market. It is fifteen inches long and is constructed of wood and metal. As equipment it carries steering and diving planes, a deck gun, and a torpedo. The motive power is derived from elastic bands, and the boat will travel from twenty to forty feet under water, at any desired depth, either straight ahead or in a circle.

The torpedo is fired from the deck gun, and is controlled automatically so that it is discharged to a distance of four or five feet as the boat rises to the surface.

Two boys, with two or three of these realistic toys and the necessary facilities for sailing them, can stage all kinds of sham battles and naval maneuvers. Blockades can be carried out and paper boats sunk in the most relentless manner, while, with the help of a few tin soldiers and "land batteries" enemy cities can be readily reduced to ruins and the garrisons routed.


The toy submarine which dives and circles. Note the heavy artillery it carries

The Farm Tractor As an Aid in Road Building

IN Atkinson, New Hampshire, the farm tractor has been successfully used in making and repairing roads, doing away with horses.

A twenty-horsepower tractor, as shown in the picture, was used in conjunction with the regulation road-machine for rounding off the surface of the road and cleaning out gutters. It was found that the tractor not only easily does the work of six or eight horses, but better and in less time. Two men only are required as compared with the four required with the former system. Besides, double the ground is covered.

This twenty-horsepower farm tractor proved itself a valuable and efficient aid in road repairing in Atkinson, N. H.

When the tractor is used with the road-drag, one man, driving the tractor, can round up and smooth as much State road in half a day as one man with a pair of horses in one day and a half. The tractor hauls four to six cartloads of gravel in the same time that a two-horse team requires for one load. Figured in dollars and cents, the tractor could easily do $24 worth of work at a cost of only $8, with an additional saving of from twenty-five to fifty per cent in time.

Trapping the Wise Old Crow

SINCE time and experiment have proved that the average crow is perfectly able to decide whether or not an object in a field can handle a gun, traps to lure the bird are now being tried out. One of the most successful of these traps assumes the form of a nest fastened securely to the branches of trees, or to any convenient support in the locality to be protected. The nest is made of strong wire mesh, padded in much the same way and with about the same materials as if made by a mother-bird. But the nest rests on a delicately balanced spring which is operated by a lever just under the eggs. When the crow gives his first investigating peck, the two sides of the supporting framework of the trap-nest come together like the leaves of a book, with bonecrushing force.

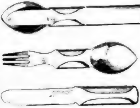
Above are shown various kinds of traps for catching the wily crow. The effectiveness of some depends on his appetite, others on his curiosity. Scarecrows are ineffective—he knows too much

Another trap which has proved successful looks like a workman's dinner pail. The cover is turned down, with just enough of an opening left to emit the tantalizing smell of cooked food. With hungry lack of caution, the crow attempts to sweep the cover off with his foot, the two steel sides of the trap, which he had mistaken for handles at the side of the pail, come together and grab him by the leg, holding him with painful effectiveness to await the further vengeance of the farmer.

A Fork and Spoon in One—Part of the Soldier's Kit

LIKE other mortals, soldiers and sailors, in training or on active duty at the front, must eat. It is not often that they object to the punctual fulfillment of this duty, provided the "grub" is fit. Uncle Sam sees to it that it is "fit" and that there is plenty of it. Every soldier and every sailor is required to carry his own kit, comprising knife, fork and spoon, and to keep it clean.

Knife-and-fork kit in detail and in use. It is very compact



There are many kinds of these kits in use, most of them combination utensils, planned with the idea of preventing the three parts of the kit from becoming separated. One of these kits has the advantage of being light, compact and simple. It consists of two parts only, each stamped out of a single piece of steel. The knife forms one of the parts while the other part has a spoon at one end, a fork at the other. The two parts, which are heavily nickeled, are so arranged that each fits into a groove in the other part, so that the sharp edge of the knife and the tines of the fork are protected.

Catching Fish Without the Use of Hook or Net

THE scarcity of meat and the consequently increased demand for sea food has made the whiting, which is also known in different parts of the Atlantic coast as "frost fish" and "silver hake," extremely popular. This fish usually begins running along the New Jersey coast in November and remains until the following May. On cold, frosty nights the fish leave their comparatively warm haunts in deep water and seek the shallow waters in search of food. Thousands become benumbed by the cold and remain stranded upon the shore when the tide recedes, an easy prey for the fisher.

A Baby-in-the-Tree-Top Hammock

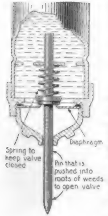
THE jingle about the baby in the tree top, which represents the height of juvenile comfort, might serve very well as an advertisement for the hammock illustrated. Made of open mesh which enables the air to circulate about the body, and equipped with a mosquito net and sun blind, it will accommodate a child up to four years of age.

The baby in the hammock is safe, for a lace which can be tightly drawn holds the body, even though the hammock should be tipped upside down. The device is made in different sizes to accommodate grown-ups as well as children, but the manufacturers claim that the child's size hammock illustrated is strong enough to hold a man, so that ample latitude is allowed to guard against all possible mishaps. This makes it eminently suitable for general use in the garden.

An open-mesh hammock with laces to draw it together and a sun blind to protect the eyes

Have You Weeds on Your Lawn? Kill Them With Gasoline

THE complete elimination of dandelions, ragweed, quack grass, and troublesome weeds that grow on the lawn is made easy by a device that eliminates all back-breaking stooping. The instrument consists of a slender tube filled with a liquid and provided with a sharp point that is pushed into the heart of the weed; the liquid then automatically runs out, and the weed is killed beyond the power to grow again.



At side detailed drawing of weed killer. Above, the same in use on a lawn

For killing dandelions and most ordinary weeds a gasoline solution is most effective, while a solution of iron sulphite is used for pig weed, rag weed, and quack grass. The device is all metal, and very simple in construction; none of the metal parts is affected by the liquids. Pressing the tool into the ground raises the valves and releases a little of the liquid. The tube may be filled by twisting the handle and removing the top.

Efficiency Has Come to the Garden Rake

ONE day, Charles F. Reiter of Minneapolis, Minn., lost his patience when raking his lawn—and who wouldn't, when the leaves seemed to take extraordinary pleasure in sticking between the teeth of the rake. After Mr. Reiter had bent down and pulled the leaves out so many times that his back ached, he threw down the rake, went into his house and invented a temper-saving, back-resting device which cleans the rake automatically.

The automatic self-cleaning attachment is simply a curved piece of wire which, manufactured in any desired length to fit any rake, sets between the teeth of the rake. Wire arms, operated by springs are attached to the handle and to the curved cleaning wire.

When the rake touches the ground, the cleaning attachment is pushed up out of the way. The leaves or scraps are raked in the usual manner. But when the rake is lifted for the back stroke, the wire arms are pressed down by two single coil springs, and the curved wire instantly pushes out the leaves accumulated on the prongs.

This simple, self-cleaning rake is the outcome of a Minneapolis man's impatience

It will be seen that in addition to saving the trouble of cleaning the rake, all the leaves, etc., that are collected would be worked into the soil, thus helping to make the "leaf-mold" that is so highly valued by horticulturists.

Homes for War Workers

A new type of standardized dwelling which can be built by unskilled labor in two weeks

By John Walker Harrington

Workmen's houses of concrete, all different from each other, can be built exceedingly rapidly and cheaply

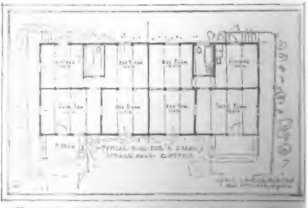
WAR workers' dwellings may be built at about half the usual cost and in half the customary time by a novel method originated by Mr. Alfred C. Bossom, a New York architect, according to estimates submitted by him to the Council of National Defence.

His scheme is the result of personal studies of actual conditions at leading American shipyards and munitions plants. It also embodies his experience as an expert retained by large industrial corporations in this country as well as by the housing committee of the London Common Council.

The construction is best adapted for fireproof materials. Wood may also be employed.

Under the Bossom plan, large sums may be saved in preparing the sites proposed. The ground for a hundred or so of workmen's cottages is leveled off at once. Then a military trench digger is run along the lines for the foundations. The resulting ditches are sheathed inside with boarding which projects a few inches above the earth. As there are to be no cellars, the work of excavation is soon completed.

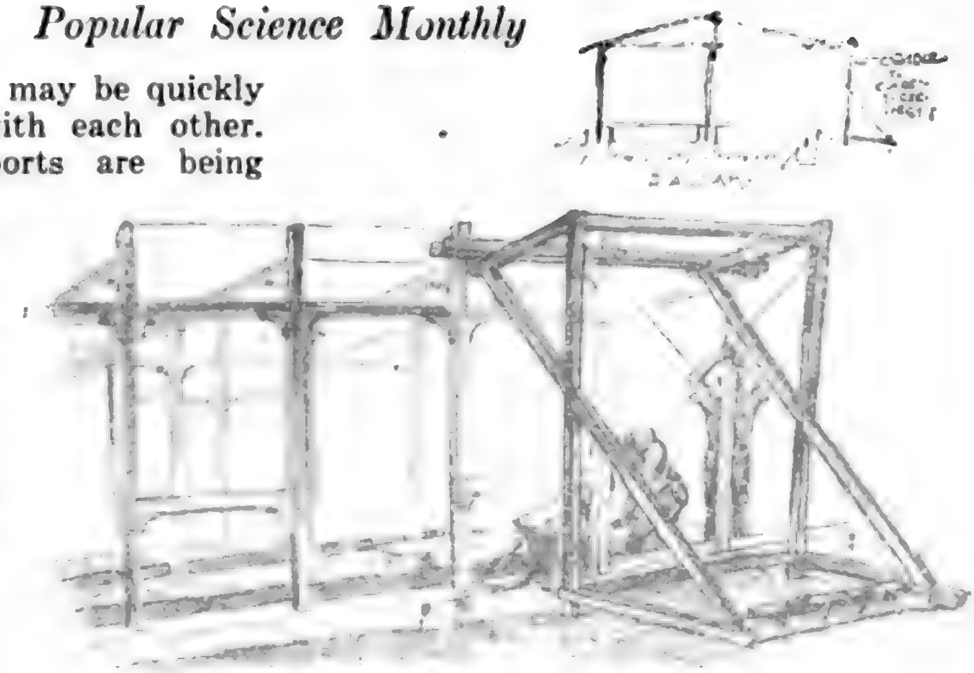
There next appear strange devices resembling the cradles on which ships are sometimes carried overland and from which they are again launched into the water. These house cradles are huge frameworks of heavy timber which are readily moved on rollers. Suspended from them at regular intervals are three uprights of reinforced concrete or steel, or even wood, which are to be part of the skeleton of the one-story dwellings. The cradles are steadied against the pull of these verticals by counterweights piled on low platforms on their opposite sides and are adjusted by wedges, until everything is made plumb. The pillars are then lowered into the trough, and their feet are soon embedded in concrete dumped into the foundation form from wheelbarrows. As soon as the cement hardens, the cradle is withdrawn and the next three posts are launched. As several cradles may be used at once in building a house, both the outer wall uprights and



Here is a typical plan for one of the proposed cottages. This particular one would be a two-family house, semi-detached

those for the partitions may be quickly trued up and alined with each other.

Meanwhile, the supports are being braced together by cross-pieces, as holes have been left in them all, where the horizontal beams may be secured. Short members are placed between the uprights so as to permit the introduction of doors and windows, the frames of which can be wired in place.



Trenches are dug by machine, and then the main supporting pillars are all dropped in together with a cradle

At the same time workmen standing on stepladders put the rafters in position, making them fast with pegs and wire, just as the other beams have been fastened. No scaffolds are required.

High rib lath is then attached to the sides and spread on the roof and firmly bound down. For the walls two areas of wire web or lath may be used, so as to give further stability. The metal meshes are then plastered from within and as soon as the plaster has set sufficiently, stucco is applied to the outside wall with a cement gun. Because of the air spaces, walls of this character have a considerable advantage over those of the poured concrete variety which often sweat and give the tenants of the house a sense of chill. The roof is also of stucco, handled in the same manner as that composing the walls. The portion of the concrete foundations rising above the earth serves as a base for floor joists and also incloses an air-chamber underfoot. Here then we have a fireproof, vermin-proof, rodent-proof and damp-proof structure.

Although these new models may be built from standardized parts, pleasing and attractive variations may be made by adding a gable here and there or altering the pitch of a roof. These one-story cottages can be erected for one family, for two or for three families, so that a village of them would not be cursed by sameness. The architect has had forty variations of the idea worked out in his drafting room. Further antidotes to monotony may be provided by painting the exterior stucco walls in different tints, and also by devising striking color schemes for the shutters, the doors and the roofs, so that there may be no two houses together which appear to be exactly alike. Here the paint gun serves both beauty and economy.

The cost of these dwellings can be kept very low, in the opinion of the inventor, because they can be built by unskilled labor under the direction of skilled foremen. Laborers whose wages would be only $2.25 to $2.50 a day could do work for which in ordinary construction the services of carpenters and masons at from $5 to $7 a day would be required.

Houses of this type, exclusive of equipment, could be erected, according to this plan, within two weeks of the time the trench digging machine went into action and under favorable conditions only one week would be required.

The installation of a general steam or electrical heating system would be provided for long in advance, or if stoves are used, the needed warmth would be readily obtained. Lighting and plumbing, although requiring the services of skilled men, could be reduced to the simplest terms.

One-family houses built under these specifications can be erected at from $700 to $1,000 each, including the cost of land in the average new industrial community. These standardized dwellings, the unit of construction, consist of a living room, a kitchen, dining-room, two bedrooms and

But the most admirable feature of the plan is this: the houses need not be all alike

a bathroom. The two and three family houses would cost proportionately less. It is estimated that a four-room and bath cottage built under the new method, could hardly be duplicated for less than $1,800 under conventional schemes of construction, using the same materials. The two family dwelling costing less than $1,200, with four rooms and bath and a porch for each user, is especially desirable.

The price of lumber is now so high that the erection of wooden houses similar in design to those here described would cost from seventy-five to eighty-five per cent of the sum expended for houses of brick or reinforced concrete. Such costs, however, vary greatly according to localities and the accessibility of supplies. Leading architects agree that after-the-war developments will justify the expense.

Real Lights for the Automobiles in Motion Pictures

MR. LANGDON McCORMICK of New York thinks that the present motion picture representations of night scenes are not sufficiently realistic, especially in their lighting effects.

It is his belief that representations of light on the screen, such as lamppost, automobile, and locomotive lamps, should be lights in reality, instead of pictorial representations.

As most night scenes projected on the screen are photographed in daylight and tinted blue to give the night effect, it is true that there is an absence of glow. But from our knowledge of motion picture projection we fail to see a practical need in Mr. McCormick's invention.

He proposes to arrange a number of tracks behind a translucent screen, upon which actual electric bulbs are to be dragged along by motors. These lights will be caused to move about on the screen to correspond with the ever changing positions of the lights in the picture.

How this corresponding movement will be accomplished we do not know, but we are certain that if it is at all possible it can be accomplished only more or less successfully in a direct side to side or up and down movement which involves no perspective changes.

As regards objects which come forward or recede in the perspective of the picture it is well understood that they change their size during their movement.

No provision is made for this change in size of the traveling lights and if this method were actually applied to a picture of an automobile going away from us into the distance the car would be seen to diminish in size while the tail-light would remain unchanged, and this effect would continue until the machine became much smaller than its tail-light. Literally speaking the automobile would disappear in a blaze of tail-light glory.

Killing Bugs with Dust

This new way of exterminating insects in orchards is fast superseding the old spraying method

Dusting machines in use in peach orchard. The powder is contained in the hopper and a blower forces it through the feed pipe under pressure by air blast, thoroughly dusting the trees

IT was formerly the custom to mix the poisons intended to kill orchard insects with water. A new method is now employed. The trees are dusted with the powdered mixture.

The tremendous advantages of the dusting method, and its success in controlling the insect pests and diseases have led to its adoption by many growers of fruits, especially in New York. A man living at Middleport, New York, has recently perfected a high-power machine which pumps the dust on the trees.

Dusting is twenty-five per cent cheaper than spraying. Orchards which it formerly took three men and a team two days to spray may be given the same protection against most insects and diseases with two men and a team in three hours time. The total weight of the dusting machine complete with gasoline is less than one thousand pounds. Wet seasons, soggy or rough land in no way interfere with dusting.

The dusting mixture is placed in a hopper. A blower, which rotates at approximately 2,500 revolutions per minute, forces a current of air through the air chamber at the bottom of the hopper. The dust is sifted through a slide feed and carried with great velocity through the outlet pipe. At the mouth of the pipe the flow is broken and the dust particles burst into a dense smokelike cloud, which will cover thoroughly a large apple tree almost instantly.

Beneath the plate at the bottom of the hopper is a slide feed regulator consisting of two diagonally slotted slides which work over each other. The position of the slides is controlled by a small hand lever conveniently located at the end of the hopper near the discharge pipe. The operator is thus permitted to regulate the amount of material to be discharged, which may be of one amount for apple trees, another for cherry, and so on.

This ladder will not slip, buckle or collapse

A Safe Ladder Appears. You Can't Break Its Rungs

CHARLES J. BROWN, of River Falls, Wis., is the inventor of a new ladder which combines many advantages and novel features. His ladder is light yet strong, and its rungs, which are of metal, are so fastened to the wooden rails of the ladder, that the structure becomes perfectly rigid.

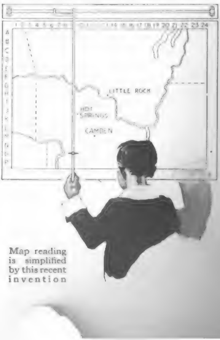
The rungs have a flat tread which prevents the foot from slipping. Safety devices are provided, which prevent the slipping of the lower end of the ladder on smooth or uneven ground, and the slipping sideways of the upper end. There is also a locking device, which makes it possible to use the invention as a roof-ladder, or in place of a trestle without extra braces to prevent the spreading of the ladder at the bottom. The ladder may be used either as an ordinary extension ladder or as a step-ladder and its rigidity enables it to stand the most severe tests.

Chemicals and Machines Supplant Men In This War

THIS is the most scientific war ever fought. There is less dependence on man-power and more on machinery than at any time in the history of the world. We pin our faith to high explosives, poison gases, tear shells, gas masks, liquid fire, etc., all of which are applied chemistry, and to machine guns, heavy artillery, automobiles, submarines, airplanes, and so forth, which are very much refined mechanics. The greatest minds in the scientific and mechanical world have pooled their brains and obtained wonderful results.

Place-Finding on Maps Is Made Easy by New Device

THE system of using index letters and numbers to enable one to find any spot on a map by referring to an index has been amplified by a device primarily designed for wall-maps, but could doubtless be adapted to smaller ones too. A rod slides along the top edge of the map and carries a movable indicator. The indicator is first adjusted to the proper place on the side index, and then the rod is moved along until it coincides with the correct letter or figure on the top index. The indicator then automatically points to the desired place.



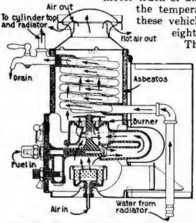
Map reading is simplified by this recent invention

Warming Both Engine and Car Body

An apparatus that will keep you warm and avoid cracked cylinders too

THE problems of keeping the engine of an automobile warm during freezing weather so as to prevent cylinders from cracking, to make starting easy and to heat the body interior for comfort are solved by the combination engine and body heater shown in the accompanying illustrations.

The apparatus works on an entirely new principle and consists of a coil-heater fired by a gasoline-burner. The coldest water is taken from the bottom of the radiator, heated, and injected into the top of the cylinder water-jacket or circulated through a small radiator in the car body. The hot water can be used for both purposes at the same time if desired by manipulating a small by-pass valve. In any event, the water finds its way back to the bottom of the radiator, thus completing the cycle of operation.



Details of a gasoline fired water heater for warming up the car and engine

The complete heater, weighing but ten pounds, is bracketed to one side of the engine. It consists of a lagged cylindrical barrel containing two coils of copper pipe and a gasoline-burner at the bottom. The fuel is carried in a tank on the running-board and is fed under pressure through a special reducing-valve to the burner so that the heater may be in operation during a short wait at the curb in the day or at night when the car is garaged.

It is claimed that the amount of fuel required to run the heater is negligible and that its use in reality saves considerable fuel because it is unnecessary to flood the carburetor when starting the engine. By keeping the engine warm, the fuel vaporizes more completely so that its full power is immediately utilized and not wasted in passing out through the muffler. The heater can be applied to any make of automobile, motor truck or ambulance. It can keep the temperature inside of any of these vehicles at from seventy to eighty degrees Fahrenheit.

The apparatus is not very difficult to install, for it is compact and self-contained. When a suitable location under the hood has been found for the bracket it is bolted on *en masse* and the proper connections run to the various necessary points. It has the great advantage of being independent of the engine.

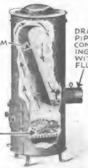
German Tires are Filled with Rags

RUBBER tires for automobiles are reported to be practically unobtainable in Germany and Austria and to give to the wheels some kind of protective elastic cushion, tire casings are stuffed with any material that affords some degree of resiliency, like cork, paper, rags, etc. In some cases the rims are without tires at all.

Showing situation of the heating unit under the hood of the car

A Simple and Effective Heat-Economizing Stove

AT a recent exhibition of heating appliances in Paris, a simple heating stove of sheet iron was shown, which, it is claimed, greatly economizes heat and fuel. The stove is intended for burning vegetables, fuels of low heat value, such as wood, peat, sawdust, bark, etc. In outward appearance the stove resembles the so-called "cannon stoves" which were so popular in this country about thirty years ago.



The hot gases of combustion and the smoke cannot reach the flue without passing around the diaphragm of this stove

The characteristic feature of the stove is a sheet-iron diaphragm, running diagonally from below the drafthole leading to the flue, upward and toward the front of the stove. The gases produced by the combustion, the smoke and the heat, instead of passing immediately to the drafthole and to the flue, are compelled to make their way up in front, then around the edge of the diaphragm, then down in the rear of the stove, to the drafthole. On their way out they heat a greater surface of the metal of the stove, giving it greater heating power without increasing the amount of fuel used.

Paint That Barn by Machine

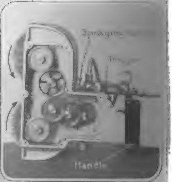
MR. F. L. BENEDICT, of Baltimore, has perfected a device for spraying paint and distributing it over a surface by means of rotating brushes.

The device consists, in its main features, of two rotating brushes with a space between them, sufficient for the paint to be sprayed on to the surface to be painted. A nozzle provides the means for spraying the paint. The brushes are rotated by a small turbine engine operated by compressed air, which is also used to force the paint to the nozzle and to spray it. The engine is connected with the brushes by a chain of gears. The flow of paint and of the air for the sprayer is regulated by a valve operated by a trigger combined with the handle. The brushes are covered with an aluminum case and rotate towards each other, by which arrangement a spattering of the paint is avoided. The total weight of the device is about six pounds.

Trials with this device have given satisfactory results—considerable economy in the cost of labor and in the amount of paint used and more satisfactory workmanship.

The rotary painting machine spreads the paint evenly and well

Details of the machine, showing the gears and controlling devices



Tilting End-Pieces for Your Eye Glasses

ARE you one of those unfortunates who are compelled to go through life with spectacles before their eyes? If so, a clever little device recently patented, will be of interest to you. The device consists of a friction hinge connecting the end-pieces with the lenses in such a manner that by a slight turning of the frame of the glasses the lenses may be brought into any angle relative to the eyes and held in that position as long as it is desired. The new end-pieces are simple and have no parts that will get out of order.

An adjustable spectacle rim for tilting the lenses to a desired angle

Remarkable Photograph of an Actual Battle Scene

ONE of the most remarkable war photographs taken by the official photographer of the British army in France is reproduced in the accompanying picture from the excellent enlargement, eight by fifteen feet in size, which was recently placed upon exhibition. This picture, probably the largest war photograph ever made, shows a wide portion of the battlefield during the actual advance of the Canadian troops at Vimy Ridge, on the morning of April 9, 1917. The smoke in the background is produced by the counter-barrage of the Germans, which was particularly aimed at a line of tanks. The Canadian curtain of fire has already swept over the battlefield and is no longer visible.

© Underwood and Underwood

This is probably the biggest enlargement ever made of a photograph. It shows the Canadian advance at Vimy Ridge and measures eight feet in height and about fifteen feet in width

The Traveling Brush-Burner. Orchardists Please Notice

This portable brush-burner saves much time in hauling and provides valuable potash for the proprietor

ONE of the simplest and yet the most convenient devices built for orchardists is the sheet-iron brush-burner built by Wm. Miller, of Gypsum, O. Mr. Miller had this constructed for use in his own orchards and therefore did not have it patented. In consequence fruit growers are helping themselves to the result of Mr. Miller's thinking.

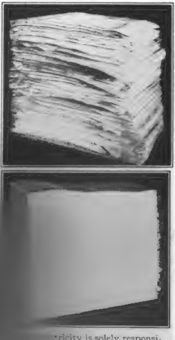
The burner is made of one-sixteenth inch sheet iron, riveted together as shown in the accompanying photograph. It is practically a large cylinder with top open and both ends closed. The top is opened the entire length, but just wide enough to admit the brush. The heat is forced upwards, rather than outwards, thus preserving the nearby trees.

This burner is mounted on sled runners. After an orchard has been pruned, the men drive through the orchard with a big blazing fire in the burner. The brush [illegible] burned as they [illegible] along. In thi[illegible] much time [illegible] When the [illegible] full of [illegible]

Static Electricity Drawn From Paper by Alternating Charge

ONE of the most annoying sources of trouble to printers is static electricity in the paper. It causes the sheets, during the process of printing, to adhere more or less firmly to the cylinder or the delivery mechanism of the press and to other sheets. The speed of the work is reduced, exact registering is made practically impossible and even stacking, whether by hand or by machine, a matter of the greatest difficulty.

An electric neutralizer has been invented which completely does away with all trouble from static electricity. It supplies an alternating charge of electricity by means of a small motor generator which gives an alternating current at about a seventy-volt pressure. This in turn is passed through a transformer where it becomes a current of high pressure and small quantity, ready for delivery to the paper through distributing bars on the press. These bars are composed of a number of fine metal points set in porcelain insulation. A bar is located near the cylinder and drop guides and, if necessary, one is attached to the delivery. As the sheets pass under a bar the charge of static electricity is drawn out.



[illegible]ricity is solely responsi- [illegible]fference in appearance

Here's the Way to Acquire Pickford Curls

FEMININE hair is usually curled by "kid" curlers. That designation has no reference to the age of the young lady but to a type of construction involving kid leather wrapped about and sewn upon thin flexible metal rods. The leather rods are wrapped about strands of hair at night. In the morning the rods are removed. Curls have grown about them overnight. But at what sacrifice to the youthful wearer! Kid curlers form hard lumps about the head, and hard lumps are painful. Sleeping with one's hair done up in such barbaric fashion is comparable to reposing upon a pillow covered with small hard rocks, which is not conducive to sleep.

But along comes Miss Ella M. Pickard, of Oklahoma, who has found a way to obtain the Mary Pickford curl without the discomfort. Miss Pickard has applied for patent rights upon a hair curler which, to our first horrified masculine glance, appeared to be a fat Havana cigar dangling from a young lady's scalp. Closer inspection brings to light a roll of soft cloth, having at either end narrow cloth straps.

The young lady who is about to enhance her crowning glory simply gathers the strands of her hair together, wrapping them snugly about the soft cloth rolls. The narrow straps are then brought together at either end of the rod, serving to hold the curl in place. When sufficient curls have thus been set in process of manufacture, she retires. The softness of the rolls prevents sleeplessness. And in the morning Mary Pickford has another rival. Painless dentistry has nothing on painless hair-curlers.

Mary Pickford curls are produced by this curler

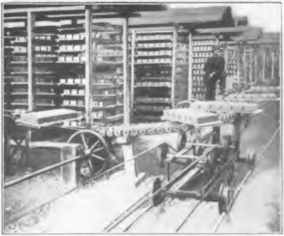
This fountain is a by-product of saving the trees from destruction by building an "island" around them

Los Angeles Values Her Trees and Conserves Them

WHEN the city of Los Angeles recently cut North Broadway through Holgate Square there was a clump of fine old pepper trees directly in the path of the grading. So the city, rather than cut the trees down, built an "island" around them. An unusual feature of the island is an ornamental drinking fountain which was built for the purpose of supplying thirsty motorists and pedestrians with a refreshing draught of Adam's ale. The water is piped to the fountain from a street main.

The Life of an Airplane Is Short

THE number of German airplanes destroyed by the French aviators and the members of the Lafayette escadrille for the ten months ending October, 1917, was one hundred and twenty over the French lines, and three hundred and ninety-seven over the German lines—all total wrecks.



This brick-conveyor is worked on a similar principle to the familiar cash-conveyor of the department stores

Brick Manufacturers Find This a Great Labor Saver

THE conveyor system illustrated in the pictures has been installed in many brick-yards in various parts of the country, and, as the owners of the yards willingly testify, has proved a valuable labor-saver. It is estimated that for a yard with a capacity of about 50,000 bricks the installation of this conveyor would mean a saving of four or five men. The system is simple and, in a general way follows the idea of the cash and parcel conveyors used in many department stores. Two endless wire cables, running parallel and supported by grooved wheels form the basis of the conveyor. The cables are stretched taut so as to support the conveyor planks and the bricks placed upon them. The tension of the cables can be regulated by a screw. By an ingenious switch arrangement provision is made for the turning of corners by the conveyor planks loaded with bricks and for the distribution of the bricks to the drying shelves extending over the yards.

The mechanism is so simple that it cannot easily get out of order. It requires but little attention and practically eliminates the necessity of employing wheelers and truckers, who are generally considered the most uncertain and annoying labor in the yard.

In these present topsyturvey times, when men have to be done without and women have to step more and more into the men's shoes, labor-saving machinery of this kind assumes an importance that it never did in the piping times of peace.

Protecting the Aviator's Camera Bellows from the Wind

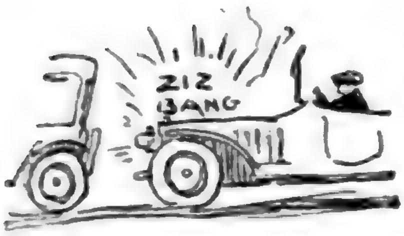
TAKING photographs from an airplane with an ordinary folding pocket camera is utterly impossible if the leather bellows is not protected from the wind, as the aviators are exposed to the terrific draft created by the revolving blades. Add to this the breeze created by the machine flying along at ninety or one hundred miles an hour and you can see why, if an ordinary folding camera is unfolded in an airplane, the wind immediately flattens the leather bellows.

Aluminum case prevents wind in airplane flattening bellows

To overcome this difficulty and to be able to procure a series of aeronautical photographs John Edwin Hogg, of Los Angeles, California, constructed the aluminum bellows shield illustrated. It worked perfectly, and with it he procured the photographs desired. The shield weighs four ounces, and when folded can be carried in the coat pocket. It may be very quickly adjusted.

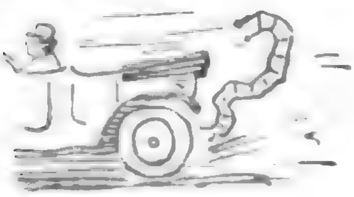
Some Do's and Don'ts for Automobilists

Economy is in the air these days. To automobilists this means saving fires, gasoline, oil, and everything else



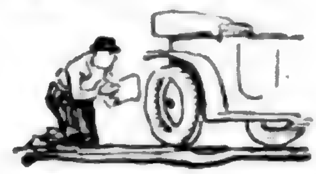
Don't keep your engine racing and banging away when you are waiting for traffic to move

Don't engage your clutch sharply, apply your brake harshly, or round corners too fast



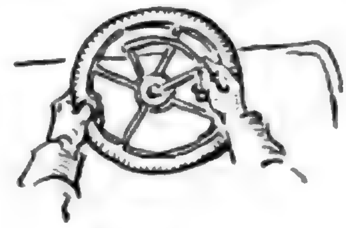
Don't adjust non-skid chains so loose that they fall off, nor so tight that they won't take hold

See that your tires are giving you service. Keep records of them and compare with others



Don't use chains on dry days to tear up the roadway; the Roads Committee will attend to all that

Drive with spark advanced as far as possible without causing your engine to labor, knock, or miss

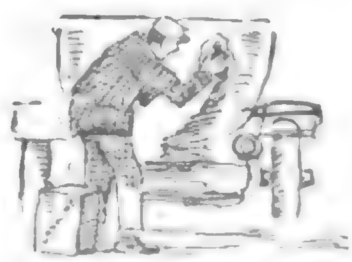


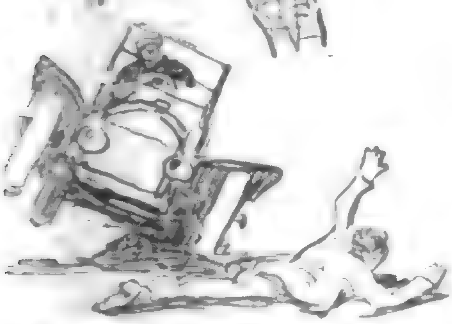
Inspect oil level in engine, amount of water in radiator, and tire pressure every time out

Study your car. Learn all its ins and outs and how to make minor repairs. You will save money

Don't wait until small cuts in your tires become gaping rents, have 'em fixed before that

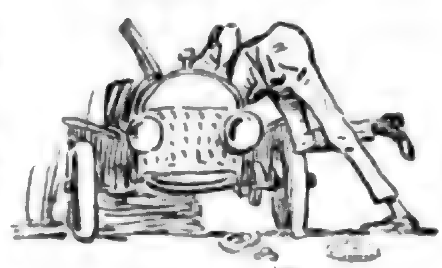
Don't wash your car with gasoline. The method is wasteful, very dangerous, and very foolish



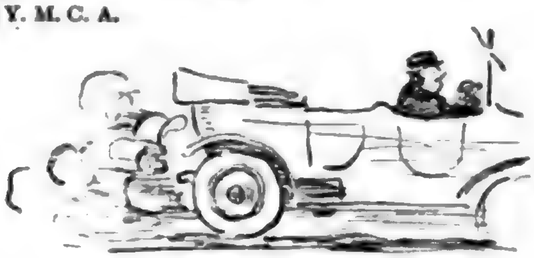


See that brakes and brake linings are all in order. You may need them in a hurry on some fine day

Don't pull your engine to pieces for the mere joy of the thing. It's not a clock and you're grown up now



Courtesy of Y. M. C. A.



Don't over-lubricate your engine and drive with the cut-out open. It's noisy and smelly

It's cheaper to cover the radiator or to use non-freezing mixture than it is to leave engine running

The first tank in position and the second being hauled ashore

The tank being towed to Powell River on a scow; tugboat at side

Transporting Oil Tanks Intact One Hundred Miles

TO convey over a distance of one hundred miles three big oil-tanks weighing in the aggregate two hundred and ten tons, without taking them to pieces, was the novel engineering feat accomplished on Vancouver Island, by Mr. S. Doe, a Victoria contractor. They were located twenty-two feet above tide-water at low stage. In order that they might be transferred to scows, trestles were built about one hundred and fifty feet from the shore line, and the whole structure to be lowered in sections. Thirteen foot poles were fixed on the scows and then run under the tanks as they rested on the trestle at low water. When the tide was at its highest the upper part of the trestle was removed. When the tide receded the tank rested on a lower elevation. This performance was repeated three times before the tank was on the scow. The tank-laden scows were towed to Powell River, where in the meantime another trestle had been built out from the shore to receive the tank at high water.

The final operation was not without its difficulties. The foundations for the tanks were more than 600 feet up a ten per cent grade. A track was built and the tanks pulled up the [illegible] engine.

Have You Got Any Use for an Abandoned Locomotive?

ABOUT twenty-seven miles from Yuma, Arizona, a sorry looking locomotive has been abandoned in the Colorado Desert. The engine was left at a gravel pit, and a flood swept away most of the track between it and the main line. Inasmuch as the locomotive is worth but ten thousand dollars and the cost of rebuilding the track would be something like fifteen thousand dollars, it is obvious that it will not be reclaimed. All parts of value that could be moved readily were stripped off, and the engine left to its fate. Standing out prominently in the sandy expanse, it is an object of considerable interest to the curious.

Cost of engine, $10,000. Cost of track to rescue it, $15,000. Result, engine abandoned to its fate

Handling Hot Firebricks with Asbestos Mittens

WHEN it becomes necessary to repair the firebrick arch in the fire-box of a locomotive the fire is knocked out and steam blown down to about half-gage pressure. Then the blower is turned on and a man enters the fire-box to make the necessary repairs. The heat is intense and is bearable for a short time only owing to the stream of cold air blown into the fire-box by the blower. The man must handle the hot firebricks quickly, yet gently enough to prevent their breakage. To enable him to do this he wears mittens of canvas with a protective layer of asbestos on the palm side to avoid burning his hands.

Asbestos-lined mittens enable the man to remove and handle the hot firebricks

These mittens can be made for about thirty-five cents a pair, and some of the large railroads have introduced their use as a matter of economy. Fifteen locomotives can be repaired before these gloves wear out, so that the cost for each locomotive is about two and one-third cents. This is a profitable investment. The injury to the hot firebricks, when carelessly handled, as they would be without gloves, would represent a loss many times greater than the cost of the mittens. In fact it would be very difficult to handle them at all, since the bricks hold the heat for a long time.

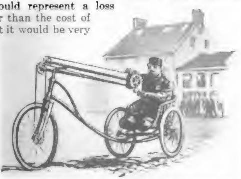
Asbestos is becoming more and more a necessity in modern industry, both for small conveniences and large apparatus, and this is only one more use.

Telephone and Telegraph Service in Argentina Held Up by Spiders

DURING the dry season in Argentina a certain species of spiders' webs collects on the telephone and telegraph wires in enormous quantities. As soon as the sun sets they become soaked with dew and cause short circuits between the wires. Eleven pounds weight have been swept from four wires over a distance of six miles.

Leglessness Is No Drawback

THE Frenchman is nothing if not ingenious. Here is a *poilu's* answer to the embarrassing question of how to do without legs. It consists of a kind of tricycle with very exaggerated handlebars, and a wicker seat, comfortably mounted on springs between the two back wheels, in place of a saddle. The driving mechanism is represented by a regular bicycle driving-wheel, having handles instead of pedals, mounted between the long handlebars in easy reach of the seat. This drives a countershaft, having a sprocket at each end, by means of a long chain, which, in turn, is connected with the front wheel by a shorter vertical chain and sprocket. Steering is accomplished in the same manner as steering a bicycle.

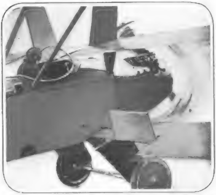


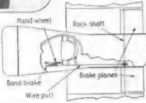
Who needs legs anyway? This novel vehicle is a poilu's idea for circumventing leglessness

It is said that this machine will make fifteen miles an hour on a good road with a husky, legless "engine." It is thus shown that even legs are not really indispensable.

Even the Laundrymen Are Affected by War Conditions

NOW it is the laundrymen's turn to feel the pinch of war conditions. They formerly used caustic potash in combination with soap for bleaching purposes. But now that potash is almost unobtainable, a good substitute has become necessary. The recent increase in the price of soap has made the need acute. And now comes a satisfactory domestic bleach. Three pounds of tri-sodium phosphate to twenty-five pounds of soap is the formula.





The illustrations show the detail and operation of a new braking mechanism that it is proposed to fit to airplanes so that they may be handled more easily

Braking an Airplane While Flying

A BRAKING mechanism for airplanes has recently been introduced. This consists of two rectangular planes of small area, mounted on a shaft that runs along the rear edge of the main plane, and passes through the fuselage. The control is by means of a handwheel and connections, which act in conjunction with a hand-brake.

When an airplane [illegible] at a rate of [illegible] miles an [illegible] air pres- [illegible] less than [illegible] to the [illegible]. It will [illegible] that [illegible] resistance [illegible] extra [illegible] of can- [illegible] great [illegible] on [illegible] the

War Sees Return to Ancient Weapons

ONE of the remarkable features of the present world war is the revival of weapons, methods of attack and of defence which originated a long time ago. Trench warfare is nothing new, but merely a modern elaboration of one of the oldest methods of defence known. The steel helmets, shields and breast plates adopted by practically all of the armies engaged in this war are adaptations of types that had been in use long before the birth of Christ. The illustration shows another revival. The French soldier pictured is in the act of throwing a hand grenade into the German trenches, perhaps only fifty or sixty yards distant. These hand grenades, which are extensively used in trench warfare, are terrible weapons. They are filled with the most powerful explosives and great care must be taken to prevent their premature explosion.

© Kadel and Herbert

Hand grenade, shield, steel helmet—medievalism personified. Nothing is new

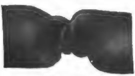
As Flexible as India Rubber but Infinitely Stronger

A WONDERFUL pipe-metal is now in use which seems to be able to stand any amount of rough usage. Our illustration depicts instances of torture to which it has been subjected without destruction. The section that looks like a piece of crumpled rag was in an Oklahoma oil well when it was "shot" with one hundred and seventy quarts of nitro-glycerin. It shrank from eighteen feet to six feet in the process, but declined to break.

This piece of pipe was originally eighteen feet long. Nitro-glycerin crumpled it up

This pipe has a tensile strength of 58,000 pounds to the square inch

The twisted piece is a section of eight-inch pipe, weighing about twenty-eight pounds to the foot, and having walls five-sixteenths inch thick. As a pipe it is not of much further use, but as a proof of metallic strength it is a masterpiece. The figure-eight knot is tied in a pipe having a tensile strength of fifty-eight thousand pounds per square inch.



713,000 inch pounds twisted this without fracture

These are only typical instances of what this uncanny metal will withstand. A twenty-six-length pipe, five hundred feet long, was blown bodily out of a Texas gas well. It lay across the landscape, twisted and turned like a gigantic frozen snake, but all its welds and joints, and the metal itself held on like grim death. The joints held, the welds held, and the metal itself was intact. There was not a break or flaw anywhere throughout its great length. As will be seen from our illustration, it is twisted and contorted like a garden hose, and when one considers that it is welded metal it is indeed wonderful.

Lengthen Your Cast with the Mercury Fishing Line

A NOVEL improvement in fishing lines is one which is made half of mercury. The process by which it is prepared is one which makes the fibers of the line absorb a mercury compound. This compound is many times heavier than the fiber of the line itself, so that the finished fishing line will be considerably heavier, though of even less diameter, than the ordinary.

A plain fiber fishing line of relatively small diameter is immersed in a bath containing a mercury compound. The mercury is then made to precipitate out of the solution and in through the crevices between the fibers. The fishing line is next taken and dressed with a mercury ointment. When this dries, the thin fishing line will be coated with a smooth, glossy surface. Then when the line is cast the friction between it and the rings of the fishing rod, as the line plays out, is much less than with other lines.

Moreover, the smaller diameter of the line makes the resistance of the air upon it less than in other cases. The drag of flowing water will also be reduced. Therefore not only will the cast of a line be greatly lengthened with this line, but, in addition to this, the line will "stay put."

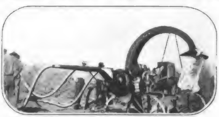
Now, all you disciples of Ike Walton, here is a new departure. Try it out on your next expedition after the fickle trout or black bass. We stake an editorial blue pencil, though, that you're scared to try it out on a "musky."

Lying like a gigantic frozen snake across the landscape, this piece of pipe has all its joints and welds unbroken after being blown bodily from a gas well in the southern oil fields

Picking Cotton with a Vacuum Cleaner

This machine does the work better, quicker, and without the waste of hand pickers

According to Government figures, hundreds of millions of dollars are yearly wasted by the careless picking of cotton. In some cases 50% of the crop is left on the plants. That explains the two thousand patents for mechanical cotton pickers that have been taken out. Not one of the inventions disclosed has proved commercially successful. About a million persons are still engaged in the picking, ginning, baling and transporting of the white fluffy stuff that goes to make up everything from gun cotton to our "pure silk shirts" and other daily necessities.



Showing the cotton-picking machine in operation. Note the compactness of the cotton

As an article of commerce, cotton was almost negligible until Whitney invented the cotton gin in 1793. The American production of cotton, which was only two thousand bales in 1791, was instantly stimulated, with the result that in 1801 it had risen to ninety-two th[illegible]. Since then, it has show[illegible]t increase, interrupted [illegible] Civil War, during which [illegible] but little cotton was [illegible]s of the Confed[illegible]

[illegible] War, cotton has [illegible] very important [illegible]ing of the war. [illegible]nce in the textile [illegible]articularly in the [illegible]es.

[illegible]n country of the [illegible]imed desert of [illegible]ow working [illegible]has already outclassed the hand pickers. What is more, the cotton it picks is even cleaner than that of the hand pickers' baskets.

The machine—called the Gabel-Holdaway—consists of a light steel chassis, supported on three steel wheels for the sake of easy handling. On the chassis supporting is a sixteen horsepower gas-engine, which drives a suction pump and a centrifugal separator. A light steel pipe runs across the machine, and from this run five eighteen-foot light rubber pipes, terminating in the peculiar picking nozzles, which the inventor claims are the reason for the success of the machine, together with the centrifugal separator.

Five men, one at each nozzle, are all that are necessary to carry out the picking

Five men operate the nozzles, one to each. The pump sucks on the hose. The manipulator of the nozzle merely sweeps it across a row of bolls, and the white fluffy cotton is sucked into the nozzle and then through the pipe to the separator. Here the cotton is separated from the incidental leaves, and from the motes. Next the

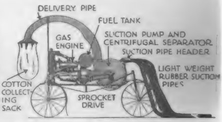


Diagram showing details of the cotton-picking machine, which is not very complicated

cotton is blown through the pipe running to the rear of the machine, where it is caught in sacks or baskets, while the finely broken up leaves and dirt are blown through openings in the pipe by which the cotton passes in its course.

Working ten hours a day, the machine is stated to pick one thousand pounds per nozzle, or five thousand pounds per day in all. Hand labor picks about one hundred and fifty pounds.

Weighing but one thousand pounds, the machine is easily moved along by means of a horse. The perfected model will use a transmission arrangement to the rear wheels, and be driven under its own power.

The superiority of the machine over hand labor was plainly shown in the Imperial Valley, where the intense heat makes hand labor hard to obtain, and inefficient when obtained. It proved easier to obtain five men at good wages to manipulate the nozzles than to secure the picking equivalent in hand labor during the hot months.

A successful cotton picker, as this promises to be, means an enormous saving in the cost of cotton production with no lowering of the profit to the planter, and the release of hundreds of thousands of badly needed laborers for other fields of endeavor.

We have heard much lately concerning the migration of the negroes northward. As they are the pickers of the cotton, may not such a machine as this have some little bearing on the future Southern economics?

Here is the gang at work. The pickers are at the nozzles and the machine is standing end on

Grownups who are not still young enough to climb trees are barred from entering

This Tree-House Is in Massachusetts, Not in Africa

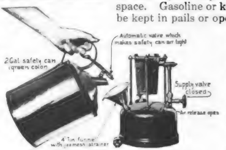
A MAN in Salem, Massachusetts, has built a playhouse in a tree for his children. It was given its lofty position in order to add novelty to its other attractions. An old tree with two branches extending straight out in two directions lent itself admirably to the purpose, but in order to make the location doubly secure, props were put under the limbs and a rod was run through the main branch of the tree and through the little house itself to the support in the rear. Thus it was made wind-proof and rigid and firmly supported.

Entrance to the house is gained by means of a ladder, if you are not agile enough to climb a tree. During the summer, when the leaves are on the tree, the children of the family have a delightfully cool and shaded place of their own. Here they reign supreme and can amuse themselves in any old way they wish, without "getting on the nerves" of the grownups.

Less Risk in Kerosene Than in Gasoline

But sand or sawdust should be kept near both of them as an extinguisher

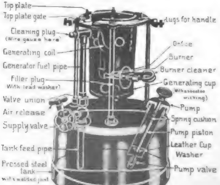
THE vapors of gasoline as well as of kerosene, when undiluted or unmixed with air, burn after ignition gradually and without explosion, but explode with great force when mixed with air in certain proportions. In the case of gasoline there will be no explosion if less than 1.4 parts by volume of gasoline are contained in 100 parts of the mixture, or more than six parts. In the case of kerosene the range of explosibility is very much narrower than with gasoline, and the danger of an explosion, therefore, much smaller.



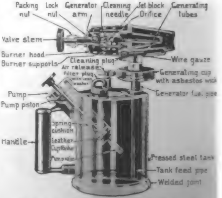
Showing the method of filling a modern kerosene furnace from a new safety can

In practical experience it was found that kerosene is much safer to handle than gasoline, besides being more economical. In many cases appliances formerly used with gasoline have been adapted to the use of kerosene. Among these appliances are furnaces and blow-torches which have been so adapted and are giving satisfaction. They are now extensively used by plumbers, painters and electricians.

Wherever gasoline or kerosene is used, the greatest precaution should be taken, to prevent leakage or the spilling of part of the liquid, especially in a confined space. Gasoline or kerosene should never be kept in pails or open receptacles of any kind, but in properly constructed safety cans, similar to that herewith shown. All taps to tanks should be fitted with drip pans. Children and unauthorized persons should not be allowed near places where gasoline or kerosene is stored, and the rules against smoking and the use of naked lights in such places should be strictly enforced. Sand or sawdust in large buckets should be kept in all places where gasoline or kerosene is stored or handled, to be used as an extinguisher in case of ignition. Sawdust is not easily ignited and, as it floats upon the burning liquid, it helps to smother the flame. Sand is also good.



Construction of modern kerosene furnace and parts used in electrical work



Details of a kerosene torch. The high price of gasoline may bring this into favor

No Race Suicide Among the Bacteria

"BACTERIA reproduce with almost incredible rapidity," says George W. Hunter in "A Civic Biology" (American Book Company). It is estimated that a single bacterium, by a process of division called fission (dividing itself into two parts) will give rise to over 16,700,000 others in twenty-four hours. Under unfavorable conditions they stop dividing and form rounded bodies called spores. These are exceedingly difficult to injure or destroy.

© Underwood and Underwood

They will not vivisect him. He tried to argue with the horseshoer, so they had to persuade him

War Provides an Expensive Clothes-Rack

THE queer thing in the middle of the picture, which resembles a monster porcupine used as a clothes-rack, is the stump of a tree which grew "somewhere in France" until a German shell struck it and cut the trunk of the magnificent tree in two. The exploding shell splintered the wood in such a manner that the stump, with its radiating big splinters was used by the French soldiers encamped there as a rack upon which they hung their clothes and military equipment. The rack may be convenient for the soldiers, but this is really too expensive a method of making clothes-racks. Besides, stumps are not always handy, and then the shell may miss them or they may splinter in some inconvenient manner. After all, the regular pattern cannot be beaten for "steady" use.

© Underwood and Underwood

How a German shell provided a very convenient clothes-rack for French soldiers

Army Horses Must Be Good-Tempered

IT'S a weary, wicked world if you are an army horse. You may or may not approve of shoes, but you've got to have them just the same. The French authorities have an ingenious contrivance which so pinions a horse that he has absolutely nothing to say in the matter. It holds his head, and holds his feet and holds his body, and forcibly prevents him from expressing an opinion, or choosing his shoes, or making a protest in any way. If they would only let a fellow get in just one real horse-size kick one could—but what's the use. In the meantime the farrier gets in his fine work, and then it is too late. Yes, it's a hard, cold, cruel world, so it is! Still, shoes are not so bad and they give a dandy heft to one's hind hoofs in arguments later on in the camps.

Where the ways of the little raindrops part—westward toward the Pacific, and eastward toward the Atlantic

Marking a Point on the Continental Dividing Range

THE big sign shown in the illustration was erected by the State of New Mexico to mark an interesting point of the continental divide. It stands near Corona, N. M., on the transcontinental highway, and attracts much attention from tourists traveling over that road. It marks a point of the continental water shed, and its position is such that the rainwater which falls on the west side of the sign flows toward the Pacific Ocean, while the rainwater falling east of the sign eventually reaches the Atlantic. Of course, there are innumerable such points along the continental divide, but only in a few sporadic cases are they marked for the benefit of tourists. If more points of interest were marked in this way it would add much to the pleasure of travel.

One Man Handles Collapsible Form

A REMARKABLY clever device has been placed on the market and promises to revolutionize the construction of concrete box culverts. It is a collapsible metal framework in sections, which forms the support of the wooden casing for the concrete. The set of forms for the construction of a culvert, thirty feet long, consists of four sections or units, which are entirely independent of one another. The frame, which is shown in the accompanying illustrations, is of iron, and adjustable laterally and also vertically. Two sizes are adaptable to thirty-nine different culvert openings. One man can set up and remove the forms.

The mechanism is exceedingly simple and easily operated. The units are set up, the casing of matched boards placed over the framework and the concrete is filled in around the casing. After the concrete has hardened, a pull at the cross-bar causes the top supports to fold up, while a pull at the center bar draws in the side sills. This deprives the wooden casing of its support and the boards separate from the concrete and can be removed, clean, uninjured and ready for another job. Trials of the device have shown that it effects a great saving in every way.


This new collapsible, sectional concrete form can be handled by one man with perfect ease

FOR PRACTICAL WORKERS

Birds Take Their Own Picture with an Electric Shutter

TO take animal pictures in the open, the camera is placed where from previous observation the animal was frequently seen. If the animal in question is a bird, the camera is focused upon a nest, or a specially made bird-house or bird bath, which the bird has regularly visited for at least a few days. It sometimes becomes necessary to hide and cover up the photographer and the camera. This may be effected by making a frame of slats and barrel hoops, covering it with muslin or sackcloth and painting the structure to resemble either a boulder or a tree-stump. This hollow structure should be large enough to accommodate the photographer with his camera. A few days prior to its being used it is placed where the animals to be photographed are accustomed to come for food so that they may become accustomed to its presence.

A wood thrush, *Turdus Mustelinus*, on a limb

In general it may be stated that no rules can be given governing the taking of animal pictures in their natural habitat. Much must be left to chance, while the imagination and ingenuity of the photographer must be called into play to secure each picture in a different manner, otherwise the pictures, having the same background, might become monotonous. But the fact remains that the animal must always be outwitted in some manner, that its inherent shyness must be overcome by some trick, in order that a satisfactory picture of it may be secured upon the film or plate.

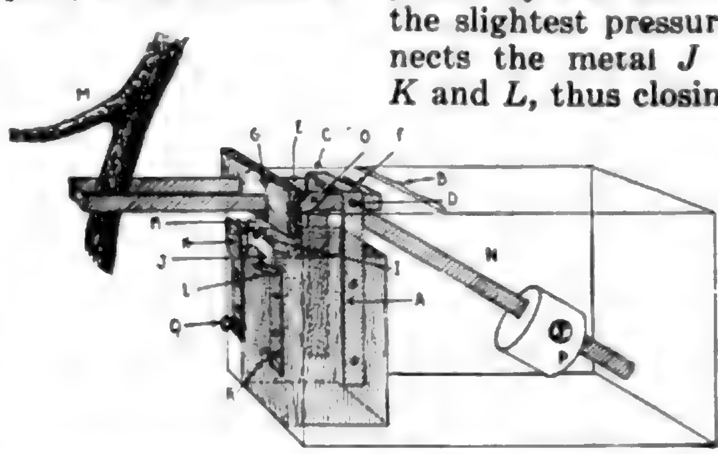
Photographs of animals taken in captivity never give us a complete idea as to their habits. The person desiring to take pictures of animals in their natural environment must thoroughly understand the life and habits of the animal.

The simplest way to secure good pictures of wild animals, is to use some kind of a device with which they may take their own photographs. Pictures taken in this way are almost invariably of the first order because they give clear, sharp and distinct negatives. Secured in other ways the pictures are often blurred and indistinct in detail as well as in outline.

A simple device used to take pictures of birds is shown in the illustration. With this device the birds take their own pictures. Birds, when flying to the ground either for food or for a bath, first hop upon a low branch or projection overlooking the place for which they are

Picture of a catbird on a post where he tripped the release operating electric shutter

flying, undoubtedly to spy out the land and to see that no enemies are in the vicinity. This characteristic of all birds is taken advantage of in this device. A sprig, top of a fence post, brick or stone is fastened to a short movable arm which is in control of the electric contacts. These contacts are adjusted so that the feathery, light body of a bird readily presses the movable arm downward thus closing the circuit which releases the shutter of the camera and the picture of the shy creature is secured.



Box enclosing all the mechanism which controls the electric switch for making contact

The construction of this apparatus is very simple indeed, as can readily be seen from the diagram. An empty cigar box was used for the house. This was securely fastened to a comparatively thick base. Long strips of iron, 1/4 in. wide and 1/16 in. thick, were used. Out of this the support *A* was made as shown in the illustration. This projects about 1 in. above the cigar box, a hole *B* was therefore bored. Two holes, *C* and *D*, situated about 1/2 in. above the top of the box, were drilled into the iron *A*. The arm *E* was then made. This projects 2 or 3 in. beyond the box. This arm also has two holes corresponding to *C* and *D*. A nail is loosely passed through these holes. This forms the axle or pivot for the arm *E*. The arm flaps are bent together and fastened with a U-shaped clip at *F*. The arm carries a block of wood *G* which is fastened just beyond the edge of the box so that it does not come into contact with it. To this block a wire *H* is attached which holds a piece of metal (copper preferable) cut as shown. The loop *I* lets the metal *J* touch both poles, *K* and *L*, which consists of two brass wires 5 in. long. The ~~ch~~ *M* upon which the bird hops, is pressed down. Another piece of metal, *N*, attached at *O* extends to within a few inches of the bottom of the box. This is the balancer or lever arm and may be adjusted by the movable weight *P* so that the slightest pressure at *M* at once connects the metal *J* with the two poles *K* and *L*, thus closing the electric circuit.

The camera is placed upon a board which carries the electromagnets. One pole of the electro-magnet is connected with pole *Q* of the box, while the other is connected with one pole of the battery. The other pole of the battery is connected with pole *R* of the box. When the twig *M* is pressed down, the metal strip *J* makes a contact with both poles. The electro-magnet becomes magnetized, draws the iron core and releases the shutter. Since the graflex has a push button to release the shutter, an angle iron is taken; a knob is placed at one extremity and adjusted so as to come into contact with the button. The other extremity carries a weight which almost counterbalances the resistance of the shutter. A slight downward pressure will now release the shutter. This pressure is supplied by the magnet. For operation of a shutter situated in back of the lens see POPULAR SCIENCE MONTHLY, June 1917.

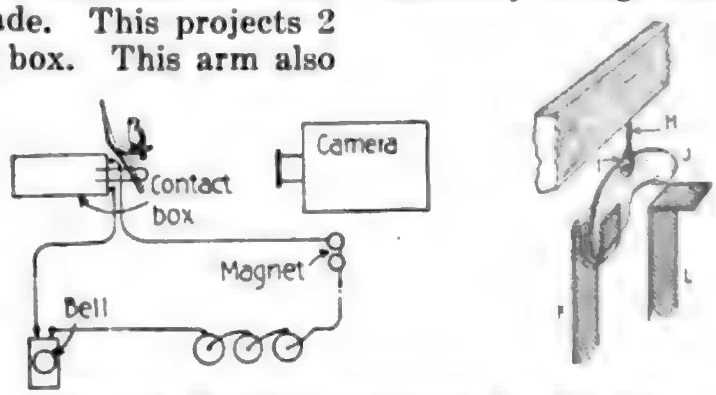


Diagram showing connections for the electric circuit and metal connector in the switch

The camera is focused upon a twig or other object placed upon the arm *E*. The instant a bird hops upon the twig, current flows, the magnet is charged, and draws the angle iron downward, releasing the shutter. Thus the picture is taken. It will be found of great advantage to introduce a bell into the circuit so that it will instantly ring when a contact is made and a picture secured, thus enabling the camera to be immediately brought in.

Holding a Board with the Weight of a Newspaper

A VERY singular experiment can be carried out with a board about 3 ft. long and a piece of paper. A newspaper will do. The board is placed on a table with one-third of its length projecting over the edge. Cover the part of the board that is on the table with the newspaper, then ask one of your friends what will happen if you give the projecting end of the board a sharp blow downward with the fist. Most people will say that the board will spring off the table. But this is just what it will not do. Providing the blow be very sudden, the board will be immovable, no matter how hard the knock may be. The board should not be too wide so that a goodly portion of the paper will lay on the table top.

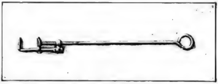
The explanation of this curious fact is to be found in the pressure of the air. It should be borne in mind that in the ordinary way the atmosphere is pressing

The board and the paper as they are placed on the table top for the experiment

on every side of objects on this earth with an even weight. If the board on the table is given a sharp blow, there is no time for the air to rush beneath the paper to the underside of the board which is close to the table. As a consequence, there is a tremendous pressure on the upper part of the board, but none on the under part. This weight of air is so great that the board will break, if the blow is hard enough, before it will jump off the table. On the other hand a slow pressure, even with the little finger, will easily move the board. This is owing to the fact that the air has time, in these circumstances, to pass underneath the board and newspaper—S. LEONARD BASTIN.

A Homemade Wrench for Turning Small Inaccessible Nuts

THE little wrench shown in the illustration was made of an old foot pump handle. The parts being round it was only necessary to drill holes through

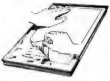


Wrench made from a foot pump rod that will work like an ordinary monkey wrench

the movable jaw and the adjusting clip then cut threads of the latter as well as on the handle for making the wrench complete. Two nuts hold the adjusting piece on the outer jaw end. This wrench is an excellent one to use when making repairs on an automobile because it turns small nuts placed in places that are otherwise inaccessible.—KENNETH WHITNEY.

Homemade Hectograph for Making Copies of Letters

A COPYING pad is indispensable to those who wish to make a limited number of copies of writings or drawings. One which is practical as well as inexpensive may be constructed in the following manner: Procure 1 oz. of the best gelatine; cover it well with cold water, and allow it to stand overnight, care being taken to see that all of it has swollen. Heat 6 oz. of chemically pure glycerine over a salt water bath to a temperature not exceeding 200 deg. F. The water that has not been absorbed by the gelatine should be poured off, and the gelatine added to the hot glycerine. The mixture obtained is heated for about an hour, and gently stirred occasionally, avoiding as much as possible any tendency of the fluid to froth or bubble. At this point add about a teaspoonful of oil of cloves as a preserva-



The gelatine mixture placed in a shallow pan

tive. It is now ready to pour into the vessel which is to hold it, while in use.

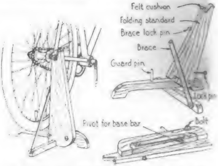
A wooden vessel may be constructed for this purpose, but a shallow cake tin of rectangular shape will serve equally well. The container should be placed on a level surface after it has received the composition, and the contents permitted to cool in a cool room which is free from dust for about 7 hours.

To use the pad it is only necessary that a small wet sponge be passed lightly over the prepared surface. When nearly dry, the first copy may be made. The writing is made in hectograph ink, which may be purchased at any stationery store. It is advisable to use a new steel pen with every original. After the writing has become dry, it is placed face downward on the pad, and the back of the paper rubbed gently to secure perfect contact. In a few minutes it should be removed by placing one hand on the sheet and pulling from a corner with the other. In this manner many copies can be made. When the desired copies have been obtained, the pad should be washed lightly with a sponge moistened with cold water. Lastly, be sure to let it dry before it is used again.—HERMAN NEUHAUS.

A Folding Bicycle Stand for the Home Shop

THIS bicycle stand not only forms a secure means for holding the "bike" in position when not in use, but also has proven itself of wonderful convenience during the arduous operations of cleaning, oiling, and tire inflating. The ease with which the rear wheel and crank shaft may be rotated to reach all parts of the sprockets and chain while the bicycle is maintained in its supported position, as shown in the illustration, make the device particularly useful, and as the stand folds, this removes the objection which its "set-up" bulk might occasion.

The details of the construction are very simple and can be readily understood from a study of the illustrations. The easiest and quickest way to form the three wooden parts constituting the frame is to saw them out of a 7/8-in. board with a scroll-saw, or easier yet, on a band-saw. The angle brace connecting the base and the standard may be formed from a piece of strap iron, or if more convenient, from 1/4-in. round iron. When the bicycle is placed on the stand, its weight, as shown, is supported by the upright standard; the felt-covered notch at the top, supporting

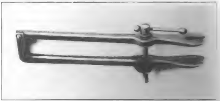


A substantial bicycle stand that may be folded into a small space when not in use

one side member of the rear wheel fork. As the bicycle hangs by one side member, the lower portion of the rear wheel swings, by gravity, against the adjacent lower edge of the standard. To guard against the bicycle being inadvertently displaced from this position, a guard pin is provided in the base. A small stove-bolt may be used to pivotally secure the standard to the base.—J. D. GARFIELD.

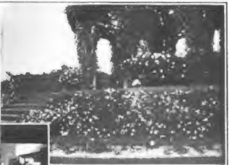
A Homemade Lifter for Gasoline Engine Valves

THE illustration shows a lifter made of metal modeled somewhat in the shape of a carpenter's vise. The ends of the jaws are flattened into a wedge-shape and slotted to fit over the valve stem.



A forged tool in the shape of a carpenter's vise for a gasoline engine valve lifter

With the spring between the jaws the screw clamp can be turned to compress it for removing the holding pin. Such a tool can be easily made by the home blacksmith.—N. A. DOW.



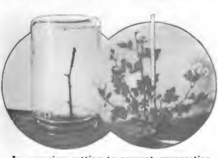
Trimming the roses properly. A bank of memorial roses and those hardy climbers, the sweet multiflora roses

Do You Grow Roses? Here Is a Little Information

THE real secret of success in rose culture is watchfulness. The rose, more than any other plant, has enemies which, if given a chance, prey upon it and spoil its loveliness. Therefore, eternal vigilance is the price that must be paid for the rose garden. A long stream from a garden hose to wash off the slugs, hand-picking to remove the chafer, frequent drenching with kerosene emulsion or sprinkling with arsenate of lead to rid the plants of the sucking insects, aphides and thrips—all are necessary at frequent intervals if one would have roses.

Such care would be too tedious, were it not a labor of love. For that reason it has been said that the first requisite in preparation of a rose garden is a special love for the flowers. The second requisite is plenty of space. The rose is aristocratic. It does not like to be crowded in with mixed company. Where roses are cultivated for the sake of the cut flowers they should be planted in rows far enough apart to permit of cultivation with a horse-drawn plow. And they should be cultivated often—not merely two or three times a season. Cultivation should be continued up to within a few weeks of the dormant period.

Roses are propagated from seed, from hardwood cuttings, softwood cuttings, layers, budding and grafting. The most common method is to use hardwood cuttings. Good, strong, well-ripened shoots of the past summer's growth are selected. These should be cut between the time the leaves fall and freezing weather. They should be cut into lengths of 5 or 6 in., with the upper cut just above a bud, and should be tied in bundles with raffia or with string that will not rot easily if exposed to dampness. After they have been labelled plainly they should be buried in moist sand, tops down, and placed in the cellar. If buried outside, they should be placed deep in the ground, below danger from frost.

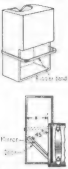


Jar covering cutting to prevent evaporation and a rose pruned to an advantageous height

Where only one or two cuttings are to be rooted, an inverted glass fruit jar may be placed over them for protection. When roots have begun to grow, the plants should be permanently set in good, watered soil and shaded for a few days from the noonday sun.

A Reflex Attachment for Use on a Hand Camera

AN extremely simple focusing device which actually transforms the ordinary view camera into a reflecting camera, is made from card-board or ordinary box-board, and is readily secured to the



Card-board box used on the back of a regular camera for reflex attachment

camera by a stout rubber band, no other fastening being required.

The simplest way to make this device is to make a paper box (or to have it made in a paper box factory) with the sides and ends entirely closed in, and lined with black paper. The height of the box should be about 12 in., whether for a 4 by 5, or 5 by 7 camera.

The width indicated in the sectional view of the illustrations by X, should be determined by measuring the distance from the upper edge of the focusing door, when it is swung back exactly 45 deg., to the rear of the camera (the entire width of the box in this direction should be the distance X, plus about 1 in. more). The lower front portion of the box is now cut away, back to the measured distance X, as shown. Next the sight opening at the rear top edge of the box is cut out, as seen in the perspective view, and the box is ready for use. The reflecting mirror, which should be about the size of the focusing door, may be attached to the box in any suitable m[illegible]—JULIUS D. GARFIELD.

Fastening a Breather Cap Securely to Prevent Its Loss

THE breather cap on an automobile engine is very easily lost, especially when the car has been in use for a considerable length of time. This is due, in many cases, to the thread on the inside of the cap wearing out and losing its holding power.

Notches in cap to hold it

To eliminate losses of this nature, remove the threads from the inside of the cap, by turning them out on a lathe. Then insert two headless 1/4-in. machine screws in the upper end of the breather pipe. Provide two slots in the cap of sufficient size to clear the two set screws.

Merely drop the cap over the pipe and then turn in a horizontal direction. The two set screws entirely eliminate the possibility of the cap coming loose.—ADOLPH KLEIN.

Spreading the Air Currents from a Desk Fan

THE oscillating electric fan costs almost twice as much as the regular fan and the air currents from it are not steady and uniform, the breeze being driven first in one direction for a short time, immediately changing to another direction. The illustration shows a new device that spreads the air quite evenly all the time. This device consists of a number of metal plates, clamped together at the angle desired, and attached to the wire protector in front of the fan. The plates, which are evenly spaced in a vertical plane, divert the air currents steadily to the parts of the room where ventilation is most needed.—J. G. PRATT.

Air spreading wings fastened to the fan

Open Canoe Cruising

II.—Description of the lateen rig and why it is best suited for the open canoe for cruising, sail-making, masts, etc.

By E. T. Keyser

THE canoe lateen, when set, resembles a leg-of-mutton sail. Its advantages over the leg of mutton type are that it requires a shorter mast, needs no mast hoops, which are prone to jam, and that the peak sets far enough aft of the mast to give good driving power. For open canoes this is the best all-around rig, as its simplicity and compactness more than offset, for the open cruiser, the greater driving power and increased windward possibilities of the batswing type of sail.

A canoe equipped with two lateen sails, which make the best all-around rig for an open cruiser

A given area divided into two sails is preferable than the same area in a single sail, as it allows of carrying a pretty fair spread of canvas in light weather and reducing to the minimum—the mizzen alone—in heavy winds. For a 17-foot canoe, an area of 68 sq. ft. will be about right. If the skipper is very light in weight, or the canoe be of 15 or 16 ft. length, a total area of 52 sq. ft. will suit conditions better.

The forward or main mast should be stepped just aft of short forward deck. The after, dandy or mizzen mast, at forward side of after seat. This arrangement calls for $\frac{1}{3}$ of total sail area in mizzen and $\frac{2}{3}$ in main sail. For a rig of 68 square feet, lay off on a floor with a chalk line a base line 9 ft. 3. in. long, as shown in Fig. 6. From right end of base line describe a circle with a radius of 10 ft. 6 in. From left end of base line describe a circle with a radius of 11 ft. With chalk line, join the intersection of these circles with the ends of base line and you will have the outline of a mainsail with an area of 45 square feet. The base is the boom, the right side the yard and the left the lea leach edge of the sail. With this outline as a pattern, lay out your sail of light unbleached muslin, running the strips parallel with the leach and allowing for a turned over $\frac{1}{4}$-in. hem ($\frac{1}{2}$ in. of material) along the three edges of the sail, and for a 1-in. strapped seam to join the strips of muslin. Get 40-in. muslin and split each strip in two so that your sail will be made up of 20-in. widths. Pin strips together as you go along and have sail stitched and hemmed on a machine. Along the three sides of sail stitch 1-in. wide non-elastic webbing. Through this webbing, on the boom and yard edges set sheet brass washer grommets 1 ft. apart, making sure that a grommet is set in each corner of the sail, and that each grommet has a 3/16-in. eye.

The dandy or mizzen sail is to be of 23 sq. ft. area and measures 6 ft. 9 in. on boom, 7 ft. 8 in. on yard, and 7 ft. 10 in. on leach. If the 52 sq. ft. rig is desired, the following dimensions should be substituted:

	Mainsail	Dandy
Leach,	9 ft. 6 in.	6 ft. 10 in.
Yard,	9 ft. 3 in.	6 ft. 6 in.
Boom,	8 ft. 3 in.	5 ft. 10½ in.

Booms and spars should be of straight-

grained pine, 1 in. in diameter at center, tapering to ¾ in. at ends, and 6 in. longer than the edge of sail to which they are to be laced. This will allow for stretching of sail and for minor errors in

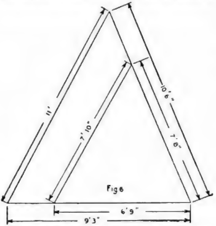


Diagram of mainsail and mizzen of a forty-five and twenty-three square-foot sail area

cutting and sewing sails to correct dimensions.

If you are a good enough mechanic to shape your spars from squared stuff, working down to an octagonal surface and then to a tapered round, very well, otherwise let a wood-working establishment shape them out from a dimensional sketch. As the masts will be short enough to be turned, they may be procured from a mill made to sketch at little more cost than the squared stock. Shape the spars first, and smooth and varnish them. Three thin coats of good spar

Method of [illegible] screw-[illegible]

var[illegible]

Each yard is joined to its boom by a pair of heavy brass screw-eyes of from ¾ to 1 in. inside ring diameter, screwed into forward ends of booms and spars and connected by a heavy 1½-in. brass ring. Screw-eyes are opened to admit the rings and then closed upon them. Capping the ends of boom and spar with ¾ in. brass ferrules will obviate danger of splitting.

Lay one of the sails out on the floor and lay its yard and boom along its proper edges. Tie with seizing line the forward corner grommet to the connecting ring, and stretch the sails out along boom and yard, fastening them temporarily to their ends. With a soft pencil mark along boom and spar 1 in. each side of where each grommet (except corner and end grommet) comes. Set a line of brass screw-eyes, Fig. 7, (3/16 in. inside diameter) along booms and spar at these marks, being careful to keep them in line, and that eyes are at right angles to length of boom or spar. Tie a loop or ring of seizing line through grommet, excepting the corner end ones. Then lace a piece of seizing line alternately through these loops and the small brass screw-eyes.

The boom jaws, round mast plate and the flag pole plate are shown in the above sketch

Stretch the sail moderately taut, fasten the outer ends by their grommets to screw-eyes set out as far as possible on boom and yard, and then, fastening the lacing at one end to the forward small screw-eye, draw it taut and lash it to the rear one, leaving a foot of extra line for [illegible] up, which may be wound around [illegible] after the last knot is tied. [illegible] buy boom jaws or make them [illegible] the latter event, get a piece [illegible]lf-round brass, 22 in. long, and [illegible]ves. Bend and hammer each [illegible] the shape and dimensions [illegible]. 8, being careful to have flat [illegible]de the curve. At a point ¼ [illegible]d of the 3 in. arm drill and [illegible] for a 3/16 in. flat-headed [illegible]. The same distance from [illegible]eneck, drill and counter-[illegible]. With two brass ma-

chine bolts, each 1½ in. long, fasten each jaw to its boom with the end of gooseneck pointing forward and its extreme end flush with boom end. Brass nuts and washers will keep the fastenings tight and

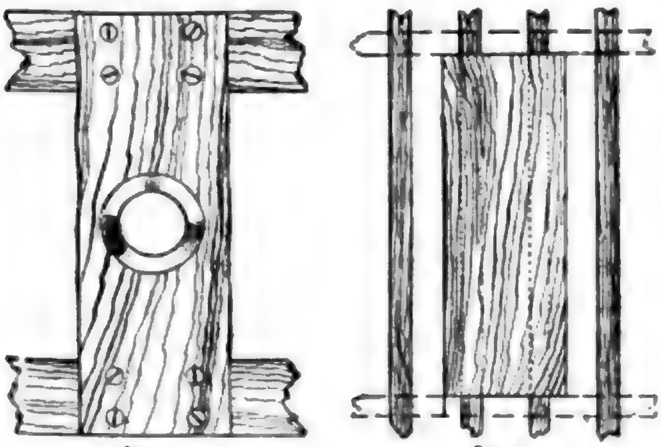


Fig. 11 Fig. 12

The brass floor plate fastened to ribs and floor grating construction to strengthen it

bolts should be sawed off flush with nut and filed smooth.

To properly step the masts you will require two 1¾ in. mast plates, Fig. 9, with four 3/16 in. machine screws ¾ in. long with brass nuts and washers to each mast plate, two flag pole plates, Fig. 10, with a 1¾ in. diameter hole. One of these will require three flat headed machine screws to fit screw holes in same, and of a length equal to combined thickness of forward deck, flag pole plate, and nut and washer. The other flag pole plate will require machine screws ¾ in. long with nuts and washers. Two pieces of ¼-in. brass will also be required whose dimensions will depend upon the construction of the canoe.

The after plate should be wide enough to extend ¾ in. beyond the flan-ge of the mast and long to ex- m the of one forward side of the next. This nd clearly illustrated in Fig. 11. em piece of the canoe termi-at triangular board, the forward plate should be of the shape of this board; otherwise make it a duplicate of the after plate. After getting the plates shaped, file down edges and round corners, so that they will not cut your hands or mar luggage. Then bore the after plate as shown in diagram to take eight ¼ in. wood screws just long enough to go through ribs without penetrating the planking, and countersink on upper side. The location of screw holes for forward plate depends upon its size and shape.

Fasten one of the flag pole plates to upper side of after end of forward deck with center of hole coinciding with center line of canoe and set as far forward as possible without allowing mast to jam on after edge of deck. The nuts and washers of fastenings should be under the deck.

Get a piece of ½ in. oak, cherry or mahogany from 7 to 10 in. wide and as long as the width (front to back) of after seat. Lay second flag pole plate on one end of this plank with centre of hole coinciding with center of plank and with hinge line flush with edge of board. Mark position of screw holes of plate on plank and drill for the machine screws that fit plate, counter sinking on opposite side from plate for nuts and washers. This plank is to be screwed to under side of after seat frame with the mast plate on under side and with hole of flag hole plate in center of boat. Round-headed machine screws, with nuts and washers coming underneath the plank, are to be used as fastenings.

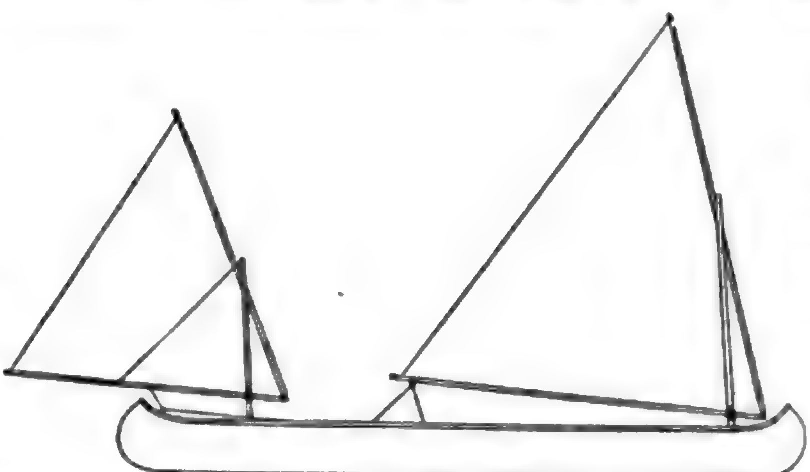


Fig. 10

A sail plan for a sixty-eight-square-foot rig with attachments placed on a seventeen-foot canoe

To hold plank in place while it and the seat frames are bored simultaneously, a pair of clamps or even monkey wrenches may be used. Stretch a line from center of stem post to center of stern post. Mark center line fore and aft on the ¼ in. brass plates. Lightly fasten these floor plates in their proper places with their center lines coinciding with that of canoe. Lay the mast plates on the floor plates, flange down, and through the flag

pole plates and into the mast plates, step a couple of curtain poles. Keeping the center of the mast plates on the center line of canoe, move them forward and backward until both masts have a pleasing and identical rake, when the position of the mast plates and their screw holes may be marked on the floor plates.

Fig. 14 Fig. 15

The shape of the blanche cleat and the clutch cleat for mizzen sheet both in brass

After drilling for these, countersink on the under side of floor plates. This permits the removal of mast plates without taking up floor plates as the nuts and washers will be on upper side.

The floor grating should be cut away as in Fig. 12 if it interferes with the installation of floor plates. Dotted lines under the floor plates indicate portions of two grating strips in way of floor plate. Broken lines along ends of plate show how these, when sawed away may be utilized as cross braces to keep the ends of shortened strips in place.

When all steps are permanently fastened, re-step the curtain poles. Near lower end of foreward one, and just high enough to keep from marring the deck, tie a brass pulley block with a $\frac{3}{8}$-in. sheave. Tie another near the mast head so that you can hoist the mainsail as shown in Fig. 13. The governing conditions are that the forward end of boom must not foul forward deck and that the after end of boom must clear head of passenger [illegible] beneath it. The mizzen should be [illegible] height above floor at jaw as the [illegible], boom should have same lift [illegible] clear after deck. Manipulate [illegible] until these conditions are met. [illegible]rk on the yards the position of [illegible] and on the masts the positions [illegible] blocks, and mast plates. These [illegible] give you data for your mast [illegible]ons. From butt of curtain [illegible] in. above upper blocks will be [illegible] mast. From floor to flag pole [illegible]hould be cylindrical and $1\frac{3}{4}$ [illegible] From flag pole plates to mast head they must taper to $1\frac{1}{2}$ in. diameter. Instead of upper block on mizzen mast, a sheave set in a mortise will be an improvement. Let sheave be $1\frac{1}{8}$ in. diameter and $\frac{3}{8}$ in. thick. Mortise to take this should be 2 in. long and $\frac{1}{2}$ in. wide and its center one inch above place already marked for block.

When masts are finished, set the halliard blocks with brass screw-eyes which have been opened and closed over the eyes on blocks. Put around each mast, 1 in. above and below each jaw a leather collar $\frac{1}{4}$ in. thick and 1 in. wide, attached with copper tacks. Soak in water to make pliable before attaching and shellac after they have dried. These collars prevent sails from hoisting too high or booms falling on decks when lowered. To keep mizzen out of the water when lowered, run an endless line through a screw-eye on masthead and through another one on boom as shown in Fig. 13. Use $\frac{1}{2}$ in. clothes line for halliards and sheets and let main sheet run through a ring on boom and fasten with a snap to a ring lashed to center of thwart. When close hauled, this gives a double purchase and when cast off in running ahead of wind doubles the length of sheet. The mizzen sheet passes through a screw-eye on after deck, as shown in Fig. 13, to a clutch cleat, Fig. 14, placed within reach of the skipper's left hand. To belay halliards, two blanche cleats, Fig. 15, are attached to right hand in-wale within reach of the right hand. That for the mainsail has the hook set aft, and that for the mizzen has the hook forward.

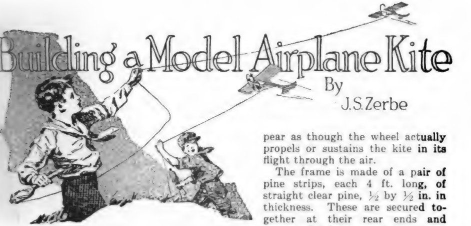
(To be continued)

Freezing a Glass Tumbler to a Block of Wood

SELECT a small, planed block of hard wood and place upon it a few drops of water and then a glass tumbler having a smooth bottom. Pour about 1 in. of water into the tumbler and add powdered ammonium nitrate, stirring the mixture constantly. As the ammonium nitrate goes into solution, it absorbs heat, producing a low temperature which quickly freezes the tumbler fast to the block, so that the latter will not fall when the tumbler is lifted from the table. Frost also gathers on the outside of the tumbler.

Building a Model Airplane Kite

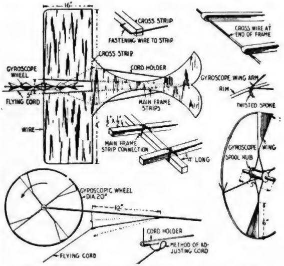
By J. S. Zerbe



KITES and airplanes are associated in the mind of the present-day boy. The former came down to us from great antiquity; but the flying machine, as we know it, is of such recent origin that the wonder due to its performances has not yet abated. It is singular that the one great weakness in airplanes is lack of control—the inability to stabilize the floating device. That has always been the difficulty with kites. The box-kite is not an old invention. That and the Malay kite have no tails, but possess inherent stability. The development of the airplane has brought out a stabilizer—the well-known gyroscope, which, when set in motion, objects to a change in the plane of its rotation. This device is now applied to a kite in such a manner as to give it a steady motion and to add wonderfully to its attractiveness when in flight.

The outline of the kite approaches the ordinary airplane structure. The gyroscopic wheel is at the forward end of the main plane, mounted on a horizontal axis, so that it rotates on a vertical fore and aft plane, giving an air of vitality to the kite, and making it appear as though the wheel actually propels or sustains the kite in its flight through the air.

The frame is made of a pair of pine strips, each 4 ft. long, of straight clear pine, ½ by ½ in. in thickness. These are secured together at their rear ends and separated 5 in. from each other at their forward ends. They are held in permanent alinement by a cross strip, also 4 ft. long, of the same material and dimensions, this strip being located 16 in. from the forward ends of the parallel strips. At the crossing points the pieces are provided with shallow gains, so they will fit together snugly, and are then secured by means of small wire nails and wrapped with a strong fine cord.



A wheel is interposed between the front ends of the main frame; the wind gives it speed for gyroscopic action

A thin, stiff, steel wire, not exceeding No. 20 gage, 6 ft. in length, is threaded through holes in the forward ends of the main parallel strips, and bent back at their outer ends so they meet the extremities of the cross strip. The detailed section of the drawing shows how the wire and strip are secured together by the two right-angled bends, the end limb of the wire resting in a groove and the short bent part of the wire adapted to enter a hole, after which the two parts are wrapped with a thin cord.

The fish-tail has at its margins a wire, properly bent and attached to the parallel strips and cross strip, thereby forming the entire frame ready to receive the covering. This may be of silk, glazed cotton, or paper, preferably waterproofed. This should be applied on both sides, or silk on the lower side and water-proof paper on the upper side, thereby making a neat and durable job. Every part of the framework is covered except that portion between the parallel bars forward of the cross strip.

Before the wire at the front part of the frame is placed into position, the gyroscope wheel must be put on the wire. The wheel is made as follows: A ring of heavy wire (No. 12 gage will answer) is bent into form, and held at the abutting ends by a tin tube. This ring should be not less than 20 in. in diameter, the object being to make the wheel with considerable weight at the perimeter, to give a proper gyroscopic effect.

A common spool is used for the hub. This should have a wooden tube through the axial bore, provided with a hole large enough to permit the spool to rotate freely on the wire. A pair of cross holes is bored through each end of the spool to receive wires. On each of the four sides these wires are brought together in pairs, and twisted to fo[illegible] the outer ends of these twis[illegible] being wrapped around [illegible] ends permitted to [illegible] of 3 in. and so [illegible] V-shaped arms. [illegible] of fabric or [illegible] these arms, and [illegible] portions of the [illegible] shaped grooves. [illegible] tion, the open [illegible] ings thus pro- [illegible] the wind will drive the wheel in the direction that the kite moves, the upper part of the wheel moving forward. This action of the wheel not only steadies the kite but has a greater or less tendency to draw down the forward end of the kite, which permits of the flying cord being placed behind the wheel.

The flying cord is attached to the cross strip behind the wheel, two points of attachment being necessary, about 10 in. apart. This cord is merely a loop, which hangs down 1 ft. or more. To this loop the main cord is fixed. As it is necessary to provide a means for adjusting the cord so that the proper angle may be given to the kite, a pair of wire arms, each 20 in. long, are secured at their rear ends to the tail of the kite, the forward ends terminating at a point below the rear cross strip of the kite. Each wire arm has a hook, or return bend, so that the looped cord may be wrapped around and secured to the hook at such a point as to give a greater or less distance between the cross strip and the hook, to enable the flyer to give a greater or less angle to the kite. The nearer the hook is to the body of the kite the flatter will be its angle in flight, and by this provision the kite is adapted to be adjusted for a wind of any velocity.

A Fine-Toothed Rake With Detachable Tooth-Holder

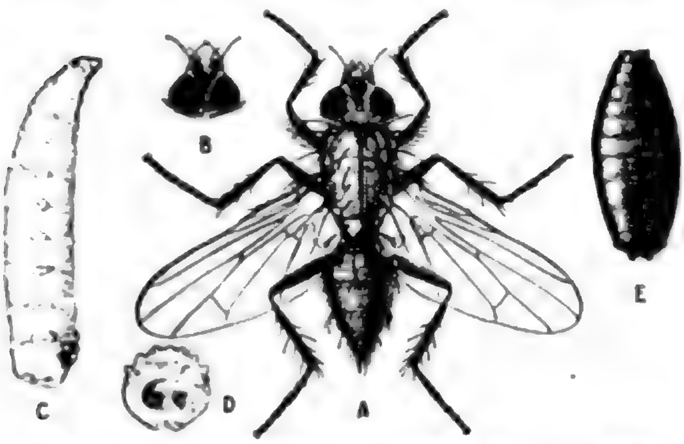
FINDING the ordinary garden rake too coarse to use among the plants just appearing, I made a rake and used it

The construction of a garden rake head in which nails are used for the teeth

where I could not handle a large rake. The illustration clearly shows the whole construction. Wire nails placed as far apart as suitable. The tooth-holding section should have the tooth-holes bored out to prevent splitting when the teeth are driven in. By having tooth-holders equipped with teeth of different sizes and set at various distances apart a combination rake is obtained.—JAMES M. KANE.

Cabbage Root Maggots and How to Control Them

CABBAGE and related crops frequently suffer severe injury from the cabbage maggot. Young plants are most seriously affected, the maggots eroding the outer surface and boring into the interior



The cabbage maggot. A, female fly; B, head of male; C, maggot; D, anal end; E, puparium

of the roots, devouring the tender rootlets and frequently penetrating the lower portion of the stalk.

This insect, also known as the radish maggot, is an imported pest, and it does very serious injury throughout the Northern States and Canada, attacking all forms of crucifers, whether wild or cultivated. In the above-mentioned region it is the cause of more or less loss to the crops year after year, but, as with other destructive insects, it is much more abundant in some seasons than in others.

Since this species also is a root feeder, the remedies prescribed by the U. S. States Department of Agriculture for the seed corn maggot are applicable. In addition there are certain preventive and other measures for its destruction that have been found successful, their use being justified by the value of the plants.

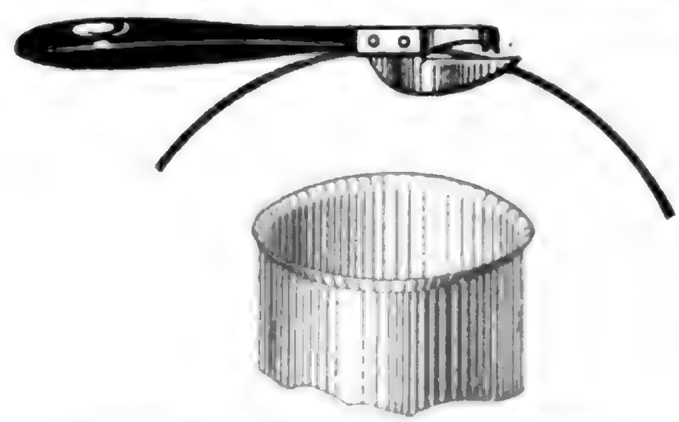
To be thoroughly effective these methods should be employed before the insect's eggs are laid. A common method for deterring the parent flies from depositing their eggs consists in placing sand soaked in kerosene—a cupful to a bucket of dry sand—at the base of the plants, along the rows. This mixture will also kill young maggots that might attempt to work through it.

When the maggot attacks radish, or other plants than the cabbage and the cauliflower, prepare a solution as follows and apply around the stalk of the plants affected. Add to 1 lb. of soap boiled in 1 gal. of water, ½ gal. of crude carbolic acid and dilute the whole with 35 parts of water. It is best to use this mixture a day or two after the plants are up or transplanted, and repeat every week or ten days until about the third week in May, after which there is less danger.

Although laborious, hand picking has the merit of being effective, and is practiced with considerable success by extensive cabbage growers, but it is not practicable with radish and similar crops. It consists in pulling up the young plants, examining the roots for eggs and maggots and crushing with the hand or by washing the roots in a strong solution of soap and then replanting. By looking closely, the minute white eggs may be seen about the stalks of the young cabbages, and if the earth is raked away so as to expose the eggs to the sun they will dry up, thus preventing the maggots from hatching. Afterwards the plants should be hilled. In most cases the plants will show no evil effects from this treatment after two or three weeks have elapsed.

Cutting a Heater Pipe with a Can Opener

WHILE replacing some hot air heater pipe a householder found it necessary to cut off part of a section. Lacking



Method of applying a can opener to the metal for cutting around a heater pipe

a pair of tinner's shears, he used an ordinary can-opener in the manner shown. The starting cut was made with a chisel. The can opener, while cutting, also produced a nice, uniform flare, very convenient for the insertion of the end of another section.—JAMES M. KANE.

The Color of Gasoline Does Not Denote Its Quality

AT one time the refineries turned out yellow kerosene and gasoline and the methods used made the liquid somewhat dangerous. For this reason, the public demanded a pure white gasoline. But the new cracking process produces a perfectly safe gasoline which has a slight yellowish tinge.

Converting a Porch Swing Into a Baby's Bed

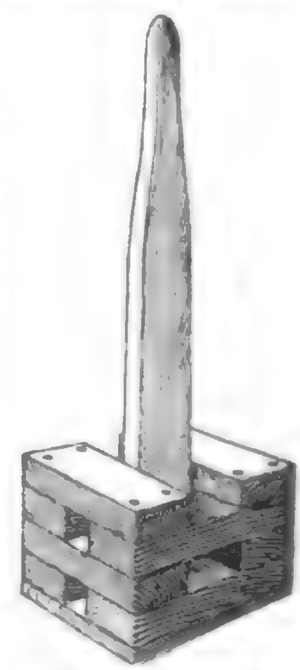
A PORCH swing can be easily converted into a cool, as well as a safe bed for the baby by attaching a swinging apron to the edge of the seat. The apron

A frame covered with wire screen to raise over the seat opening for making a baby's bed

consists of a frame made the same size as the opening between the two arms of the swing and covered with wire screen. The frame is hinged to the front edge of the seat so that it can be swung up and fastened with hooks and eyes to the outside of the arm. Another hook can be attached to the under side of the seat and an eye fastened into the frame so that it may be used to keep the frame from striking the legs of the occupant when the bed is re-converted into a swing.—J. A. FITZPATRICK.

Making a Lawn Leveling Tamper of Wood

TO make a handy tamper for leveling lawns, paths, etc., first procure a 12-ft. piece of 2 by 4-in. scantling, and a section of planking about 10 by 12 in. in size. From the scantling cut four pieces each about 10 in. long, four pieces about 12 in. long and one piece about 4 ft. long. This last piece should have one end whittled down into a rounded handle.



Tamper made of wood pieces

The method of constructing the tamper can be best understood by referring to the drawing, which shows the eight short pieces of scantling nailed together in the form of a "crib" with the 4-ft. piece in the center as a handle and the section of planking nailed to the bottom to make a smooth surface. Obviously scraps and odd pieces of scantling of the proper size can be used in place of the 12-ft. piece. Also the number of short pieces can be varied to obtain the weight that is desired.—FRANK L. MATTES.

Removing Yellow Stains from Piano Keys

PIANO keys, by use, will turn yellow. To restore the original whiteness, put 1 oz. of nitric acid in 12 oz. of soft water (pour the acid slowly into the water—do not reverse this or the acid will fly up into your eyes) and apply the liquid to the ivory with a brush, taking care that no acid gets on the woodwork. Wash off the acid with a piece of flannel dipped in clean water and wipe with a dry cloth. Besides restoring piano keys, this same mixture is equally efficacious for cleaning the handles of cutlery and other similar articles.

Simple Designs for Sheet Metal Working

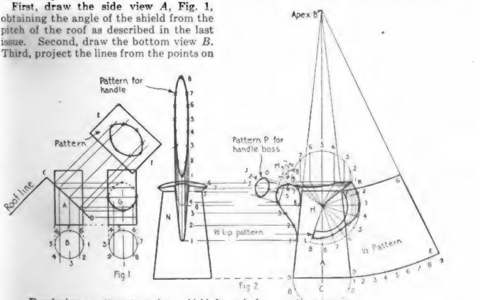
XII.—Interesting pattern problems developed by means of radial lines

By Arthur F. Payne

Director of Vocational Education, Johnstown, Pa.

IN the last issue, one of the problems developed was the pattern for the hole in the shield of a hopper. The illustration Fig. 1 shows the method of developing the shield for a "jack pipe" or bath room ventilator pipe coming through a roof, (in the illustration the roof is drawn very small). The method used is exactly the same as for the hopper, but as the hopper was developed by radial lines and this jack pipe is developed by use of parallel lines, it will make it much easier and make a good review of the method if we briefly outline the steps of the development.

First, draw the side view *A*, Fig. 1, obtaining the angle of the shield from the pitch of the roof as described in the last issue. Second, draw the bottom view *B*. Third, project the lines from the points on the bottom view circle upward until they meet the shield line *C-D*. Fourth, project lines out exactly at right angles to the shield line *C-D*. Draw the center line *E-F* Now it will easily be seen that these lines give us the length of the hole, also that if we can get the correct widths on these lines we shall have the pattern of the hole. To get these correct widths we must draw the front view *G*, which is done as follows: Fifth, draw the pipe and the bottom view being careful to note that the numbers are turned a quarter turn to the left, number one being in front instead of on the right side. Sixth, project the lines up from the bottom view until they cross the same numbered lines coming over from the side view. Mark these points with a cross. Connect these crosses with a curve and we will have a correct view of the front view of the joint of the pipe and the shield. The upper part of the joint is drawn in dotted lines because it is back of the pipe and cannot be seen. Seventh, with a pair of compasses measure the



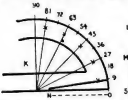
Developing a pattern to make a shield for a jack pipe and also a pattern for making a liquid measure

different widths and place them on the same numbered lines on the pattern. Mark with a cross and then connect these crosses with a curve and you will have the pattern for the hole.

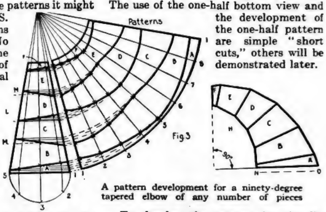
The next problem, Fig. 2, that of the measure, gives us four patterns to develop, all of which are very interesting. The drawing appears somewhat complicated on account of overlapping lines, but if you will follow the directions carefully you will have no difficulty.

Government Proportions for Graduating Liquid Measures

Before we develop the patterns it might be well to know the U. S. Government proportions for liquid measures. No matter what the size of the measure, the diameter of the bottom must equal two-thirds of the vertical height, the diameter of the top must equal two-thirds of the diameter of the bottom.



Protractor



A pattern development for a ninety-degree tapered elbow of any number of pieces

LIQUID MEASURES

Sizes in inches

Size	Height	Diameter Base	Diameter Top
1 gallon	9.80	6.53	4.35
½ "	7.78	5.18	3.45
1 quart	6.17	4.11	2.74
1 pint	[illegible]	[illegible]	2.18
½ pint	[illegible]	[illegible]	1.73
1 gill	[illegible]	[illegible]	1.37

	Diameter Top
[illegible]	6¼ inches
[illegible]	6½ "
[illegible]	9¼ "
[illegible]	10½ "
[illegible]	11½ "
[illegible]	13 "

... the method of ... exactly the same The method used in Fig. 2 is as follows: To develop the pattern for the body of the measure. First, draw the front view *A*, the correct size and proportion, continue the side lines up to the apex *B* and draw the one-half bottom view *C*. Second, with the dividers strike the pattern arc *D-E* getting the correct length by stepping the eight spaces of the bottom view. Third, strike the arc *F-G* and the one-half pattern will be complete.

This series has been running long enough now for those of you who have worked out all the problems to be ready to adopt "short cuts" and quick methods. The use of the one-half bottom view and the development of the one-half pattern are simple "short cuts," others will be demonstrated later.

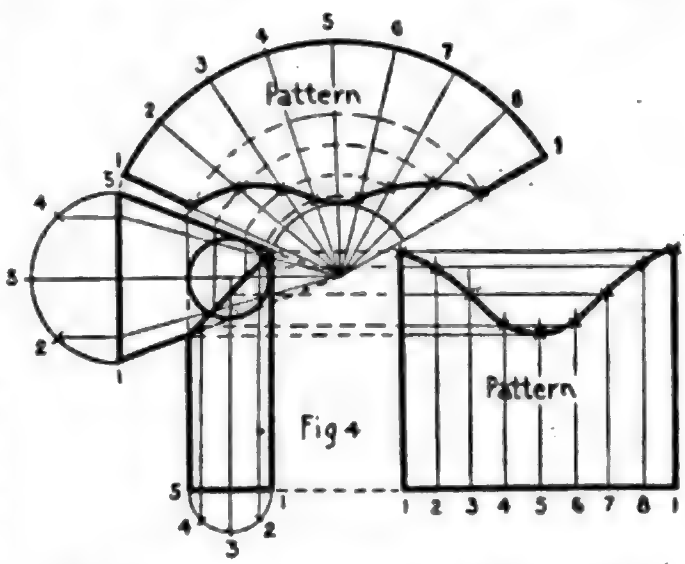
To develop the pattern for the lip which is merely part of a cone, the apex of which is at *H:* First, draw the outline of the lip, then draw the complete cone of which it is a part by continuing the side lines. Second, draw the one-half bottom view *J*. Divide it into eight equal spaces. Project these points to the base line, then to the apex *H*, where these lines cross the outline of the lip. Draw lines straight over to the side line to get the true lengths as you have done before on previous problems. Third, draw the pattern arc *K-L*, getting the correct length by laying off the eight spaces from the bottom view. Draw lines from these points to the apex *H*. Now swing the lines over from the side line until they cross the same numbered line coming up from the arc *K-L*. Make a cross where the lines cross, connect with a curve, draw the arc for the lip to join on to the body and the one-half pattern for the lip is complete.

The "boss" on the inside of the handle is part of a cylinder so it must be developed by parallel lines just as we developed the elbows and tees in previous issues. In this pattern we use the same principles as in Fig. 1. First, from the front view project lines upward and draw the section view *M*, obtaining the width from the other view of the handle marked *N*. Second, divide the section circle of the boss into four parts. Project points 2 and 4 down to the front view of the boss. From where these lines cross the handle, draw lines at right angles. Draw the line *O-P*. Now we have the true length of the pattern. We can get the true widths from the sections view, measuring off four of the section spaces on line 1-5 on the pattern and two on line 2-4 of the pattern, do the same with the lower half, connect these points with a curved line and the pattern for the handle boss is complete.

The pattern for the handle is a new application of some previously demonstrated principles in parallel lines. First draw the view *N*. Second, divide the outline of the handle into any number of spaces as shown by the crosses. Project these points across to view *N*. Number them as shown. Third, draw the center line of the pattern, get the correct length by measuring with compasses the spaces on the outline of the handle and transferring them to the center line of the pattern. Be sure to give each point the same number on the pattern as it has on the other views. Fourth, project lines up to the pattern from the points on the *N* view of the handle. Make crosses where these lines cross the same numbered line on the pattern. Join the crosses with a free hand curve and the pattern for the handle will be complete.

A simple problem that is often confusing to the ordinary sheet metal worker is illustrated by Fig. 3. The problem is that of developing the patterns for a ninety-degree tapered elbow of any number of pieces. This elbow has six pieces and the small diameter is one-third that of the large diameter. These patterns may also be used for a ship's ventilator, although this type of ventilator should not be confused with the regular oval ventilator which is developed by "triangulation." This method will be explained later in the series.

Each section of the tapered elbow is part of a cone as can be seen in drawing *L*. To develop the patterns: First, draw a cone, the base of which is equal to the diameter of the large end of the elbow. Second, on the upper part of the cone draw the line for the small diameter of the elbow. The altitude of the cone may be varied to suit the length of elbow required. Third, we must now obtain the miter lines. This is done in exactly the same manner as explained in the October 1917 issue for ninety degree cylindrical elbows. The rule given there is: "In all elbows of more than two pieces, the two end sections should be one-half the size of the other sections." In this case,



A pattern for another type of a ninety-degree reducer elbow used for a ventilator

there are six sections to the elbow so the four middle sections will each have twice the number of angles in it as the end section. This is shown in drawing *K* which illustrates the use of a "protractor" which is a small brass "angle measure" and can be bought for 25 cents. The crosses indicate the miter lines. Note that the two end sections have only 9 deg. each, while the middle sections have 18 deg. each. Take the diameter of the cone base and lay it off as *N-O* on the drawing *K*. This will give the exact shape of section *A* on the cone. Lay this off as section *A* on the cone. Take the distance on the center line of section *A* and set off the same distance on the center line for section *F*, then divide the remainder of the center line into four equal spaces. Draw the miter lines at an angle of 9 deg. to the line *M* which is

drawn at right angles to the center line, starting at the four equal division points. Develop the pattern for these sections in the usual manner, using "radial lines" as described before. Briefly the steps are: Draw the one-half bottom view, divide into four equal parts, project lines from these points to base lines then to apex, strike arc for pattern, get correct length by stepping off eight spaces from bottom view, from where the lines from the base to the apex cross the miter lines, draw lines at right angles over to side of cone to get the true lengths, swing these points over to the pattern until they cross the same numbered lines on the pattern, make a cross where these lines cross, connect crosses with free hand curves, and pattern will be complete. The drawing *H* shows the proportions of the finished elbow.

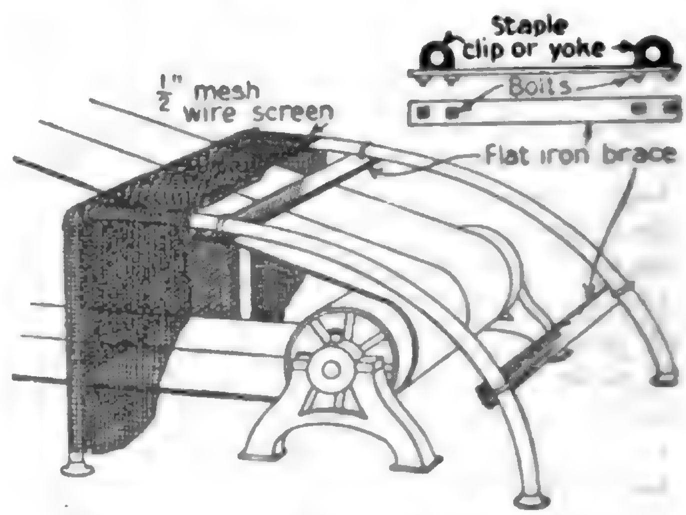
The illustration Fig. 4 shows another 90-deg. reducer elbow, which is often used for a ventilator. The details of this development will not be given as they have already been explained many times in this series. The reason for giving this problem was to illustrate a new and interesting method. When drawing this reducer, great care must be taken to have the joint at 45 deg. to the center line of the pipe and of the cone. To do this, draw a circle equal to the diameter of the pipe and then draw the cone so that both its outside lines are tangent to the circle as shown in the drawing. This will bring the outside lines of both cone and pipe just touching the circle, as shown in the drawing. The pattern for the pipe is developed by means of parallel lines, the pattern for the cone by means of radial lines.

Do Not Use Fuel Savers. Regulate Your Dampers Instead

AN old fireman says, "Not one person in ten operates the draughts of his furnace properly or handles his coal to good advantage." It will be found that the coal savers, of which there are many, are accompanied with a set of rules, which, if observed, without using the saver, would go a long way toward conserving fuel. Do not spend money on these chemical compounds. The most sensible practice is to sprinkle the coal with water before throwing it upon the fire.

Bracing for Belt Guard to Cover Floor Countershaft

A BELT guard frame to cover a floor countershaft was built of pipe and fittings, with wire cloth stretched over them. This caused the two parts to be



A guard frame of pipe and fittings placed over a countershaft attached to the floor

pulled together at the top. The braces to hold the upper parts at the right distance from one another were made of flat iron, $1\frac{3}{4}$ in. wide and $\frac{3}{8}$ in. thick with U-bolts to clamp around the pipes.

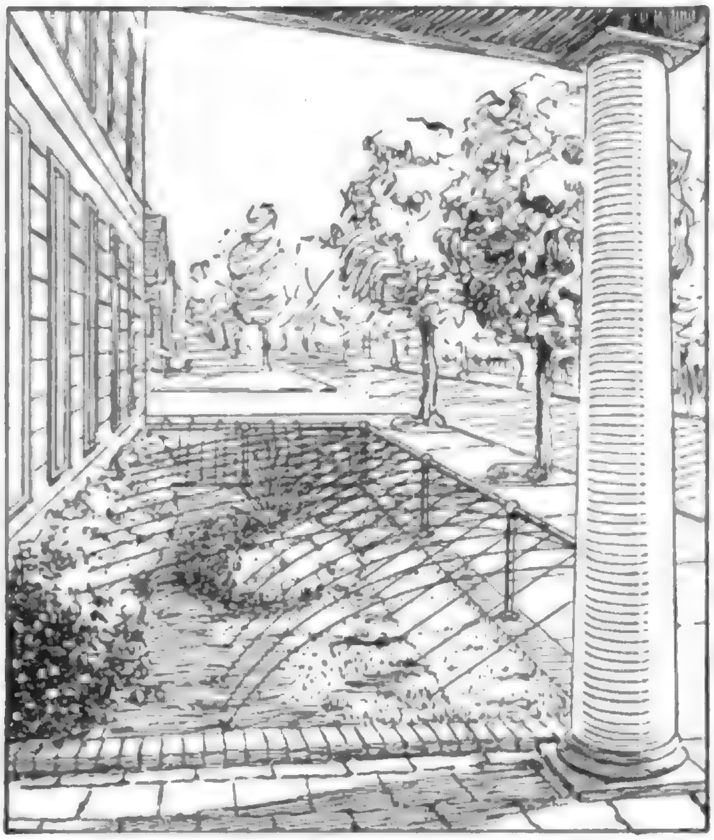
This method of guarding belts is excellent as it affords a clear view of the machines, while the flanges permit the whole frame to be unbolted and unscreened quickly when necessary.—JAMES M. KANE.

Carrots Used as a Substitute for Eggs in Puddings

IN these days of high prices, anything that can be used as a substitute, and give good results at the same time, will be a welcome addition in helping to keep down the high cost of living. Boiled carrots, when properly treated, form an excellent substitute for eggs in puddings, etc. Boil the carrots until they are tender and nearly ready to fall apart; drain carefully, and mash and press through a coarse cloth or strainer. The pulp is then introduced among the other ingredients of the pudding and the eggs totally omitted. Puddings made in this manner are lighter than where eggs are used, and are more palatable. The carrots also impart a fine yellow color to the pudding so that nobody can tell whether eggs were used or not.

Here Is a Combination Fence and Lawn Sprinkler

IRON pipe ¾ in. in diameter is extensively used for protecting the small grass spots between the sidewalk and the street curb, also between the sidewalk and the building, providing the space is not large. These plots are very difficult to keep watered in dry seasons. One resident owner made a combination fence, using the pipe for the sprinkling apparatus as well as for the guard. Small holes were drilled in a row on the inside surface of the pipe and the whole line was connected with the water supply. In building such a protection be sure to have all joints watertight and the tees plugged that are used to connect the iron supports for the posts.—THOMAS W. BENSON.


The pipe guarding the grass plot is used for sprinkling the ground in a dry season

Changing Ink Into Water. This Is Black Magic

THE performer introduces to the audience a glass or bowl of ink which is covered over for an instant by a lady's handkerchief, during which time it becomes changed to clear water. This trick can be performed with any sized glass from a miniature tumbler up to a large fish globe. The fish globe will be described here, as it differs but little from the smaller sized glasses.

There is made to fit inside of the globe a lining of alpaca, or black silk without any bottom, and around the top of which runs a wire over which the alpaca is turned to prevent it from falling down. The lining is made to fit the glass as closely as possible. When the water is poured in and presses the cloth out against the glass, the globe appears to be full of ink.

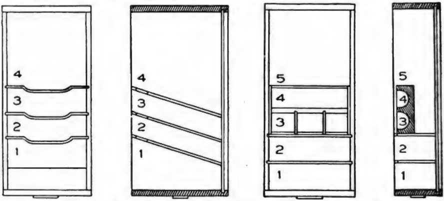
This is exhibited to the audience, and to prove the genuineness of the fluid, the performer takes a ladle and dipping it into the bowl, pours out some of the ink into a plate, which is sent around. The ladle is made with a hollow handle which has a small hole at the bottom, leading into the bowl of the ladle. Another small puncture is made within 1 in. of the top of the handle. Before commencing the trick, ink is poured into the ladle bowl, which, when the ladle is tilted, runs up into the handle, but is prevented from flowing back again by a finger or thumb placed over and covering the top hole. The ladle can, therefore, be held in any position without fear of the hidden liquid coming out. When it is dipped in the globe it is not allowed to enter the water, but is only lowered to the surface, the finger at the same time being removed from the hole in the handle, allowing the ink to flow down and into the bowl of the ladle, from which it is then poured into a plate and handed out for examination. The former next borrows a large handkerchief with which to cover the bowl and touching the glass with his wand commands the ink to vanish. When the covering is lifted the bowl will be found full of clear water, with gold fish swimming in it. In snatching off the handkerchief the wire ring is grasped and whipped off under cover and dropped into an open drawer at the rear of the table. This trick is extremely effective when adroitly done, as the transition seems so obvious because of the sample handed around in the ladle. The magician should not forget to "patter" while doing the trick.

Arrangement of a Stenographer's Desk for Accessibility

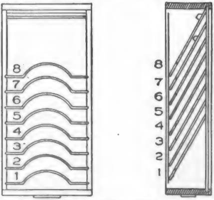
AFTER receiving a large number of suggestions from various customers a typewriter firm has worked out an efficient and handy arrangement for a typewriter desk in which all of the various letter and bill heads as well as other supplies may be kept within reach of the stenographer. All of the drawers are intended to be open when the stenographer is at work, the general movement being from right to left.

The upper right drawer has compartments which are used as follows: sheets for carbon copies, 1; thin white paper for additional copies, 2; inter-office letter heads, 3; general correspondence letter heads, 4; heavy white paper for long memorandas and second sheets, 5; folder of carbon paper, 6; special letter heads, 7; and telegram blanks, 8.

The lower right drawer consists of compartments 1 for No. 6 and 10 envelopes; 2 for inter-department messenger slips, inclosure slips and a pyramid of pins; 3 is for erasers, clips and rubber bands; 4 is for well-sharpened pencils and 5 for No. 6 and 9 envelopes and note books. The left drawer has compartments, 1, finish work; 2, letters to be answered and other papers being used in connection with work; 3, carbon copies, and 4, miscellaneous supplies and forms, personal belongings, cleaning outfit and dust cloth.



The arrangement of the upper right and lower left drawer to the desk for keeping the various kinds of paper used in correspondence, envelopes, pins, clips and the pencils



The left drawer has compartments for finished work, letters to be answered and other papers

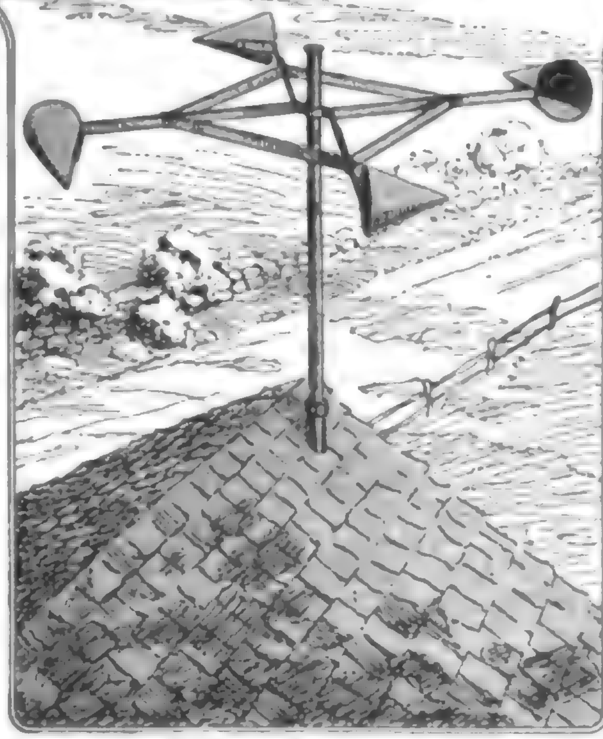
Do You Want Your Tires to Last? Then Fill Up the Cuts

THE service of tires will be abbreviated to a considerable extent, if cuts, punctures, and snags are neglected. Too much care cannot be exercised in avoiding injuries of this nature as much as possible or, at least, in giving them the proper attention within a reasonable period.

New macadam roads, especially when wet, are liable to damage rubber covers. It is recommended that the speed of the car be slightly accelerated and the clutch depressed before coming up to loose, crushed stone in the road.

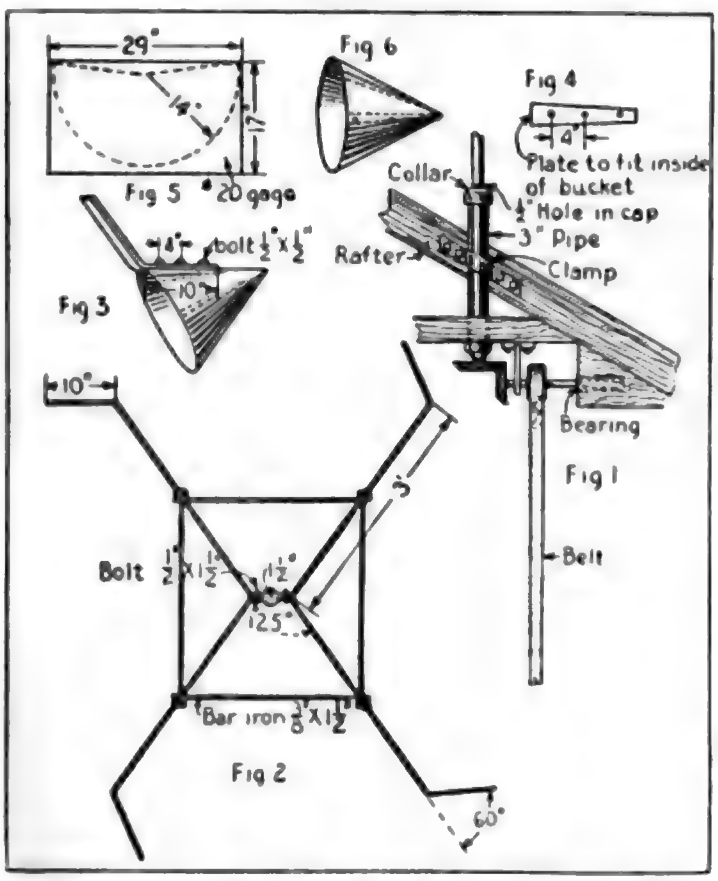
A Bucket Type Wind Motor

By O. B. Laurent



The manner of mounting the wings of the wind motor on the roof of the shop

THE necessary power to drive small machinery in the repair shop may be obtained by the use of a wind-motor as shown. Such a motor may also be used to operate pumps and electric generators for charging storage batteries. The device is easy to construct and is inexpensive, the material being obtained from any hardware store. The driving connections, such as the beveled gears and hangers may be obtained from old, discarded machinery. An old mowing machine will furnish the bevel gears. A piece of 1½-in. pipe will serve for the main shaft, the length depending on the position in which the motor is set in the roof; the buckets, however, should be at least 4 ft. above the roof to obtain the best results. One method of transmitting the power from the motor is shown in Fig. 1. However, the builder may choose any method that will better suit his purpose. The object of the drawings is to show the construction of the motor and installation of the buckets at the proper angles, as shown in Fig. 2. The construction of the cross-arms may be readily understood from the illustration. The method of fastening the buckets to the arms is shown in Fig. 3, using plates, Fig. 4, on the inside of the buckets. The pattern for the sheet-iron to form the buckets is shown in Fig. 5. Mark out the sheet as indicated by dotted lines and then cut it out, which will allow for a ½-in. lap. Next shape the sheet as shown in Fig. 6, and punch the hole to receive ½-in. bolts. The buckets are then bolted to the cross-arms, using the plates, Fig. 4, on the inside. The cross arms and buckets are now complete.



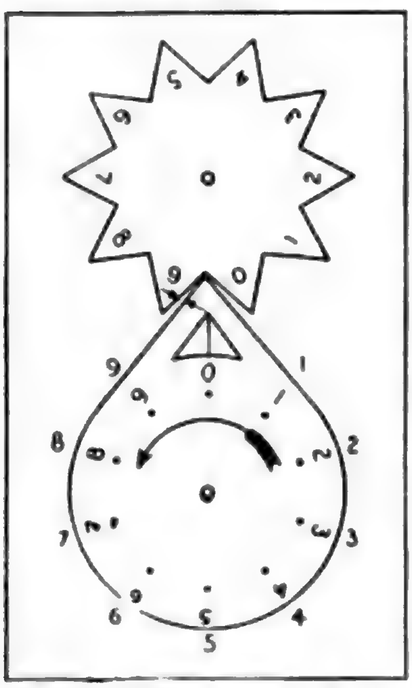
Details of the wings and the method of forming the buckets and the bevel gear

The bearing to receive the main shaft is made of a piece of pipe 3 in. in diameter with both ends threaded to receive ordinary pipe caps. Drill holes 1¾ in. in the center of the caps, to receive the shaft. The completed bearing is fastened to one of the rafters as shown in Fig. 1. The shaft is run

through the bearing, collars being used to hold it in place. The cross-arm is bolted at the end of the shaft, care being taken to screw the nuts up tightly so that the arm will not slip on the shaft. The bevel gears and pulley may be fitted, using an ordinary shaft hanger next to the gear. The other bearing may be made by using a pipe nipple filled with babbitt metal and bored to fit the shaft. It is then fastened with screws to a rafter. The dimensions given are for a motor of small power, but they may be increased proportionately for a higher powered motor. The motor will always revolve in the same direction, no matter from which point the wind may be.

Making an Adding and Subtracting Machine of Cardboard

If our brains performed arithmetical labors in the same way that calculating machines do their work we should certainly have wheels in our heads, for circular motion is the basis of every practical calculating device. Since our system of numbers has ten for a basis almost all the engaging wheels of computing machines have teeth that are ten or a multiple of ten in number for convenience. The first step in the construction of the adding machine herein described is to divide the circumference of a circle into ten equal parts. There are scientific ways of doing it, but trial measurements with a pair of dividers on the circumference will soon produce a close approximation. To construct the machine you will need a smooth board 5 in. long, 4 in. wide and ½ in. thick; some heavy cardboard—the stouter the better—for the two number wheels; two flat-headed wire brads for axles, and a wire nail about 1½ in. in length.



Numbered cardboard wheels for the adding machine

To make the lower wheel of the machine draw a circle on the cardboard 2 in. in diameter, then draw two tangents that meet at a point beyond the circle. Divide the circumference into ten equal parts and number in black ink the division points as shown. Following the lines of the tangents with scissors cut out the pear-shaped figure, and with a sharp knife make a small triangular opening in the V-shaped projection.

The other wheel of the machine is also 2 in. in diameter and the circumference is divided into ten equal parts. Describe a concentric circle about ¼ in. inside of the outer circumference, then carefully cut the teeth as shown. To do this with precision you should also divide the inner circle into ten equal points and make marks midway between the division marks of the outer circle. Using these marks for guides you will have no difficulty in cutting the teeth accurately. Number the second wheel in ink from 0 to 9 inclusive—a number on each tooth.

The machine is now ready to set up. Fasten the cogwheel first. Place it on the board in such a position that the teeth do not overlap the upper edge and fasten it by one of the brads driven through the center, drawing it well down against the pasteboard, but not too tight to prevent it from turning easily.

With a pin for a temporary axle, determine the proper position for the lower wheel. It should be such that when the wheel is turned the projecting point shall engage the teeth of the upper wheel, but will permit them to pass without cramping. When the position is correct, drive a brad through the center to make all parts secure.

Mark the board with the numbers shown. Use a soft pencil and be guided by the numbers on the lower wheel. Draw a pencil guide line between the two wheels so that it will appear through the triangular opening. In addition the small arrows, one on the point of the lower wheel and the other on the cog number 9 of the upper wheel are drawn. Make deep indentations on the lower wheel on the inside of each of the numbers with a rather dull knife. These serve as a holding place for the point

of the large wire nail that acts as a sort of a movable handle. The machine is set when the points of the arrows are exactly opposite. The lower wheel always turns from left to right. It is now ready for adding a column of figures. Take the figures 8, 9, 6, 9, 8, 7, 7, 9, 3 and 2 and add them. Insert the point of the wire nail in the indentation of the lower wheel opposite the number 8 of the board. Pay no attention to the numbers on the wheel until you finish adding. Turn the lower figure wheel with the nail until the point is opposite the guide line. Lift the nail and place the point in the indentation at number 9 of the board and turn the wheel until the nail is opposite the guide line. Again lift the nail, insert the point opposite the number 6 of the board and turn the wheel until the nail is once more opposite the guide line. Add the other figure in the same way. The sum total of the column will appear at the opposite ends of the guide lines, namely, 68.

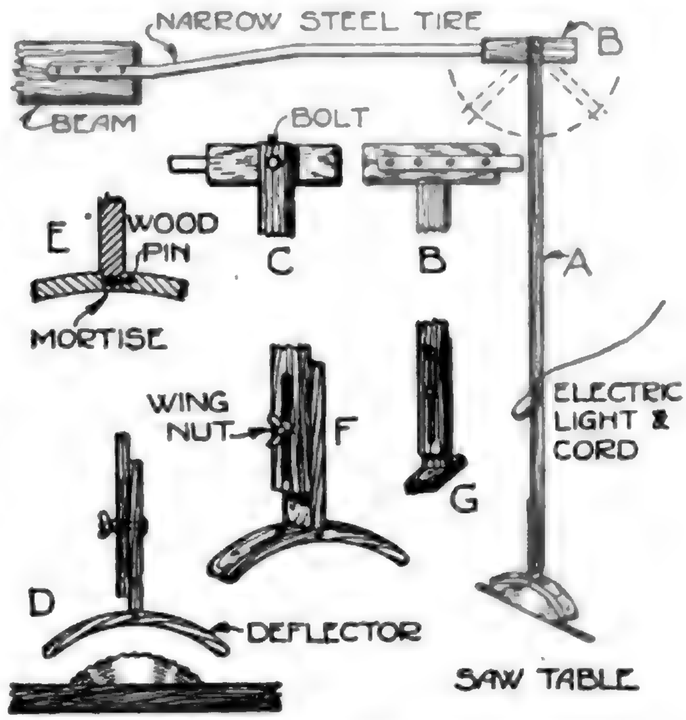
The capacity of the machine is 100, but by keeping tally of how many times the cog number 9 passes the guide line, you can use the machine for any column of figures. This machine is also a subtracting machine. To subtract with it, set the upper wheel so that the first digit of the minuend appears at the guide line, and then set the lower wheel so that the second digit of the minuend also appears at the guide line. Now place the nail opposite the subtrahend marked on the board and move the lower wheel clockwise—in the opposite direction to that indicated by the arrow—the number of spaces equal to the subtrahend. As in addition, the result appears at the guide lines. When there are two digits in the subtrahend place the nail in the hole opposite the digit on the board and, as in the first case, turn the wheel a number of spaces equal to the subtrahend.

The subtracting numbers of one digit, the zero mark on the upper, or tens, wheel must be set on the guide line, since the tens place is not represented in the minuend.

This machine is not difficult to make, and it will be found very convenient by anyone who does much figuring but not enough to warrant the purchase of a machine.—E. P. THORNTON.

A Simple Sawdust Deflector for a Circular Saw Bench

TO do away with the confusing spray of dust which a circular saw throws up, particularly when cutting heavy lumber, a wheelwright made the adjustable sawdust deflector, shown in the



The parts for making an overhanging sawdust deflector for a circular saw table

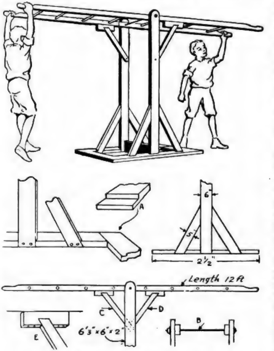
illustration, to cover his circular saw. A length of narrow tire steel was bolted to an overhead beam and bent so as to bring it over to the saw as shown. This supports the vertical arm, *A*, of the deflecting device. A short section of wood, *B*, was bolted to the end of the tire steel, and to this in turn, the vertical arm was secured by a bolt, *C*, which permits the deflector to be swung away from either side of the saw table.

The deflector proper, *D*, consisted of a curved piece of wood 2½ or 3 in. wide and about 1 in. thick, mortised to a 12-in. vertical section of the same width. In order to eliminate any chance of accident due to cutting through of the deflector, a wood pin instead of a bolt was used to secure the mortise and tenon *E*. Vertical slots in the ends of the arms *F* and *G* permitted the travel of the wing-nut used for raising and lowering the deflector. Hanging a light on the deflector arm made it possible to adjust both arm and light in one operation.—JAMES M. KANE.

A Balancing Ladder for Use in the Home Gymnasium

THE balancing ladder was designed for indoor use. In making it care should be taken to have all the parts properly finished so that it will look neat, as well as give good service. The base consists of a frame made of 2 in. plank and when finished it forms a rectangle 30 by 48 in. The joint used at the corners is shown at *A*. The upright planks are 6 in. wide and are fitted into notches cut on the inner edges of the platform pieces. The braces for the uprights are fitted to their own depth.

The ladder proper is made of sound, straight-grained hardwood, with each rung glued and nailed in place. The pivot is made of a bolt as shown at *B*. When it is desired to maintain the ladder in a horizontal position, the braces *C* and *D* are let into the notches in the blocks as shown at *E*. The lower ends of these braces are bolted to the upright post and may be quickly taken down. When the device is completed, smooth all parts with sandpaper and apply two coats of spar varnish. For permanent locations, it may be bolted to the floor, but it is preferably left portable. The construction permits this and only ordinary care is necessary to prevent accidents. For healthy, growing boys this apparatus will provide endless fun and exercise.—A. ALDON.



A portable balancing ladder and details of its principal parts. The ladder is tilting or made solid

Mounting Photographs So That They Will Not Curl

THERE are very few amateur photographers who have not encountered the unpleasantness of pasting photographs on mounts and have them curl up, mount and all. The dry mounting method overcomes this difficulty, but one must have a hot iron. However, the difficulty may be overcome by the use of rubber cement such as is used for patching the inner tubes of bicycle and automobile tires.

The cement is applied in a thin, even coat on the back of the print and the face of the mount. It is allowed to dry, or become "tacky" before placing the print on the mount. When the print is laid in place it is rolled down just as in ordinary mounting.

As the cement will slightly discolor the mount, if it is white, it is best to cover the entire surface, then when the print is in place the uncovered border may be easily cleaned of the cement by rubbing with the finger end. Roll it into a ball and use the ball to clean the edge near the print. If any of the cement gets on the face of the print it can be rubbed off in the same manner.

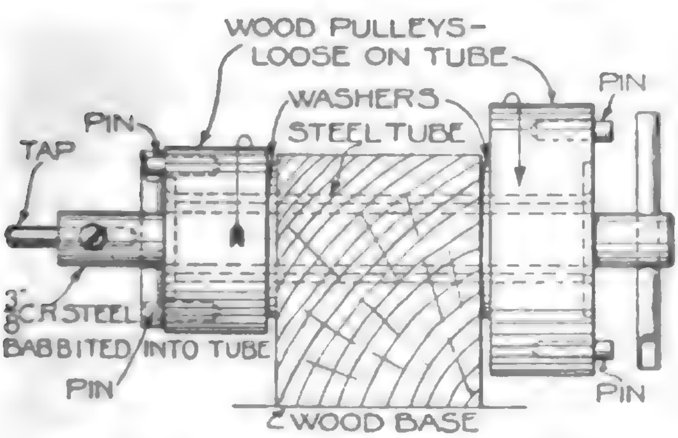
If the print does not stick properly it is because the cement was not left long enough before the print was applied to the mount. Dry the print well after mounting, so that the surface of the mount will not peel off in removing the cement.

Tricks of the Trade

A simple means of driving taps by power and a small vise for the work bench

Homemade Power Tapping Machine for Rapid Work

As it was necessary to tap several thousand ¼-in. holes in many cast iron fittings some means of driving the tap had to be provided. There was no tapping machine in the small shop, but



Opposite revolving pulleys drive the tap in either direction according to the pressure

the foreman was equal to the occasion and quickly made the tap driver shown in the illustration. The shaft was made from a piece of steel tube about 6 in. long and ¾ in. outside diameter. Two wood pulleys were fitted to this shaft, one on each side of the bearing or support. One of the pulleys was turned to 3 in. in diameter and the other to a 2-in. diameter. A countersunk washer was fitted into the two outside faces of these two wheels and the edges of the pipe were beaded out to prevent them from slipping off.

Before attaching the pulleys, a piece of cold rolled shafting ⅜ in. in diameter was centrally babbited into the tube. This shaft was then provided with a central hole at one end to accommodate a tap, which was secured with a grub screw set into a slight depression ground into the tap shank. The shaft is provided with a carrier or dog at each end as shown. These dogs engage with the pins fitted into the outside surfaces of the pulleys.

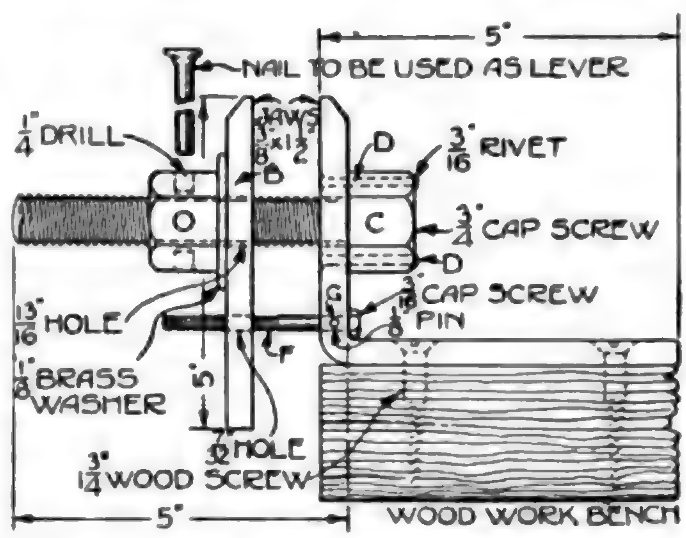
The shaft is arranged to slide axially inside the tube, the amount of the sliding motion being so proportioned that when one set of pins engages one of the dogs, the other set of pins is disengaged.

The smaller pulley was used to drive forward and the larger one for backing up. It will be seen that on pressing the work on the tap, the shaft is pushed back and so engages the pins at the front of the machine on the small pulley. Pulling outward on the work draws the shaft out and thus disengages itself from the pins on the small wheel and immediately engages with those on the large wheel, which revolves in the opposite direction, backing the tap out of the piece.

The tube was held stationary in a wooden block fastened to the bench. One of the belts was crossed. The surfaces of the pins where they engage were filed flat to make them act promptly.—John L. Allen.

A Homemade Bench Vise for Small Work

The illustration shows a cheap and quickly-made small vise for the model maker. It is suitable for any medium and light work. The vise is made from two pieces of band iron 1½ in. wide and ⅜ in. thick, with the jaw *A* bent as



Two pieces of metal and a cap screw with guide pin makes a model maker's vise

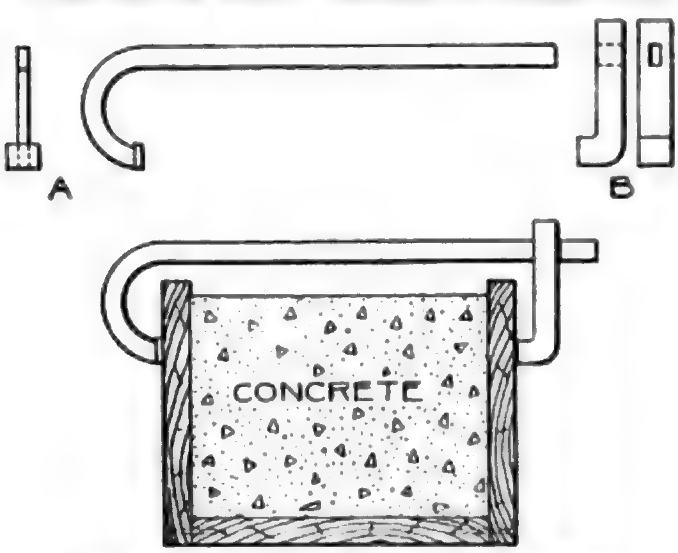
shown and the jaw *B* cut straight, with two holes drilled in it. The top hole is 13/16 in. in diameter and the one matching it in the top of the jaw *A* is ¾ in. in

diameter. The cap screw C is fastened with two rivets, one at the top and one at the bottom, to the jaw A. The rivets D are countersunk on the inside of the jaw. The brass washer on the outside of the jaw B is made of an old piece of 1/8-in. brass, and allows the nut E to draw up tight and hold it in position. It is not necessarily round.

Drill 1/4-in. holes in the faces of the nut E and cut off the end of a nail to fit the holes. This is used as a lever for tightening the nut. The nut may be drawn up very tight, when necessary, with a wrench. The 3/16-in. cap screw F is held in the jaw A with a 1/8-in. taper pin, as shown at G, and this bolt acts as a slide guide for the jaw B, which holds it in a vertical position. The lower hole in the jaw B is 7/16 in. in diameter—large enough to slide over the threads on the bolt F.—P. P. AVERY.

An Easily Operated Clamp for Concrete Forms

MANY uses may be found for the clamp shown in the illustration. There are no screw threads to bother with



An easily constructed clamp for holding the forms in making concrete structures

and there is but one moving element. A contractor can have a number of these made by the local blacksmith or machine shop and use them in construction work of any character.

A cold rolled bar, 1 in. by 3/8 in. in diameter and about 3 ft. long should be heated and forged at one end into the shape shown on A. A short bar, 1 in. square and 10 in. long, should be fashioned similar to B. The hole in the latter should be just large enough to allow A to slip through with a close fit. It is the lever action which, pressing the diagonally opposite edges of the hole against the bar A, causes the bar B to wedge and hold. The greater the pressure tending to force the clamp jaws apart, the greater the holding resistance.

In building a large concrete structure, a contracting company used hundreds of these clamps for holding temporarily in position the wooden forms for beams, window sills, and stairways. A great saving in time as well as money was made, as they did away with the old method of nailing wooden cross-pieces to the forms. They are easily portable and may be moved from one job to another as soon as the concrete sets.—K. M. COGGESHALL.

A Receptacle for Holding Graphite in a Clean Way

EVERYBODY knows how hard it is to pour graphite from any ordinary container without having it spill or come out too fast and make everything black. If the graphite is put in a discarded tooth-powder can (the kind with the regulating slot in the top) not only can its flow be regulated but it is kept clean and dry.

A Simple Homemade Sun Drier for Fruits and Vegetables

SUN drying is undoubtedly the simplest and most inexpensive method of preparing fruits and vegetables for winter storing. A simple drier that can be made at small cost consists of a shallow box with a sash or piece of glass fitted over the top. Bore holes in the sides and near the top and bottom, for ventilation; but cover them carefully with netting to keep out flies and mosquitoes.

Set the box at an angle so that the sun's rays fall directly on the glass. Apples, peaches, apricots, cherries, raspberries, and almost all fruits can be dried in this way satisfactorily. First wash the fruit carefully, discarding any that show signs of being over-ripe or decaying. Slice thin, and lay out in the box without overlapping the slices. Turn the slices occasionally and take them out as they dry. The only thing to guard against in this type of drier is dust and insects.

The Amateur Electrician And Wireless Operator

A Clip for Removing Insulation from Wires Quickly

IN the accompanying sketch is shown a handy device for making the operation of removing the cotton or other insulation from electrical conductors easy and efficient. The clip is very simple to make as it merely consists of a piece of steel 1/16 in. thick and ¾ in. wide, bent into the required shape, as shown, then ground and tempered at the cutting edge. Triangular notches are ground or filed in the cutting edge before tempering, make the operation of pulling the insulating material from the wire easier. As a protection to the hand, it is advisable to cement or rivet a piece of leather to the strip.—PETER J. M. CLUTE.

The sharp edge removes insulation quickly and evenly

A Depth Indicator for a House Water Tank

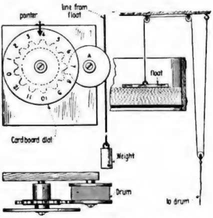
THIS depth indicator was built to automatically gage the depth of water in a small house tank and was built entirely of odds and ends of the kind found about any work bench or household.

A drum was made of a cylindrical piece of wood 2 in. in diameter furnished with two rims of cigar-box wood 2½ in. in diameter. The top rim was then cut down to the diameter of 2 in. except at one point where a tooth was left projecting out ¼ in. and about the same width, as shown at *A*.

A second disk 2½ in. in diameter was then cut from cigar-box wood and its circumference serrated with 13 teeth similar in size to that on *A*, and the space between them sufficiently wide to fit well over it.

The drum was then drilled through the center and mounted as shown on a solid base so to revolve easily about the screw in the center. The toothed disk was then glued to a length of a large spool to bring it in line with the tooth on *A* and mounted on a pivot so the teeth would engage readily without binding. The tooth disk was pivoted in the center of the base.

A card-board disk was then glued over the toothed disk, their centers being placed concentrically. This card-board disk was then pointed off with 13 equidistant marks, each mark lying directly over a tooth of the gear underneath. They were then numbered from 0 to 12, the tank being 12 ft. in depth. A metal pointer was fastened to the top of the base so it pointed down and over the card-board dial as far as the numbers.

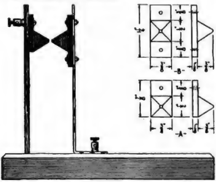


Drum and float with an indicating wheel to show the water level within a small tank

Next a flat board was placed in the tank as a float and a stout line led from it over little pulleys down to the drum on the indicator where it was wound around several turns. A heavy weight was fastened to the lower end of the line. The length of line on the drum was a little more than the total depth of the tank. With the float on the bottom of the tank the dial was set so the pointer rested over O. Then, by means of the pulley system, every foot rise in the level of water revolved the drum once, which moved the engaged gear one tooth, representing one foot of water. When the level of the water lowered through use the action was reversed.

A Combined Microphone and One-Way Telephone

A SIMPLE, but fairly powerful microphone may be constructed by the amateur very inexpensively. It may also be used as a one-way telephone for experimental purposes.



The two carbons as they are mounted on the base to make the sensitive microphone

The base is constructed from white pine, and is 3 by 4½ by ⅝ in. The edges are beveled, and a groove is cut on the top to receive the sounding board. This board is made from the same material, and is 2½ by 4½ by ⅛ in. The illustration makes clear that it must be perpendicular to the base of the instrument. It should be carefully glued in place and permitted to dry thoroughly. Then the whole thing should be shellacked, or coated evenly with a thin coat of varnish.

It is necessary to procure an old worn-out dry cell for the construction of this piece of apparatus. The carbons are taken out and shaped as indicated by *A* and *B* of the accompanying sketch, and small holes drilled in them, as shown, to accommodate the two screws and the binding-post. The two tetrahedral-shaped carbons are placed directly opposite each other and their respective bases should be exactly parallel to each other. The carbon that is opposite to the one attached to the sounding board is held in place by means of a copper or brass strip which is so constructed that it enables the builder of this instrument to make it of any width he chooses as long as it is able to stand rigidly without any support, and is flexible enough to bend to and fro slightly in order to make adjustments when necessary. It is suggested that use be made of a buffing machine or similar apparatus in conjunction with an emery wheel, when possible, in order to cut the carbons to shape. However, if this is not possible, a sharp file can be utilized. The carbons should be adjusted so that the two points touch lightly. The instrument is then connected up with two dry cells and a 75 ohm receiver. The cord may be made 70 feet long for experimental purposes. If the specifications are carried out as herein indicated, it is possible to hear a person whistle or sing even though the receiver is 50 feet from the sounding board. A person walking in the room where the board is placed, can be distinctly heard.

Restoring Bichromate of Potash Used in Battery Solutions

BICHROMATE of potash used in electric batteries can be restored so that it can be used over again. The bichromate of potash battery in whatever form, is one of the most powerful and handy electric batteries to use where high-voltage and large current are required for a short time, for general experimental work. By treating the used up residue of bichromate of potash or bichromate of soda solutions which are thrown away as useless, they can be made to give electric currents over and over again. In order to give them a new lease of life the method is as follows:

In generating an electric current the bichromate of potash is converted into chrome alum, and all that is necessary to do is to convert it back again into bichromate of potash by fusing it with an oxidizer. Heat in a crucible, to incipient redness, a mixture of chrome alum (or chromium sulphate, if bichromate of soda was originally used), and nitre, using about equal parts of each and stir until the elements are fused. Test a portion of the fused mass by dissolving a small amount of it in water. If a pure yellow or an orange colored solution is obtained; the crucible may be withdrawn. If the solution is still slightly green, add more nitre. When the color is right, pour the material on to a stone or iron plate.

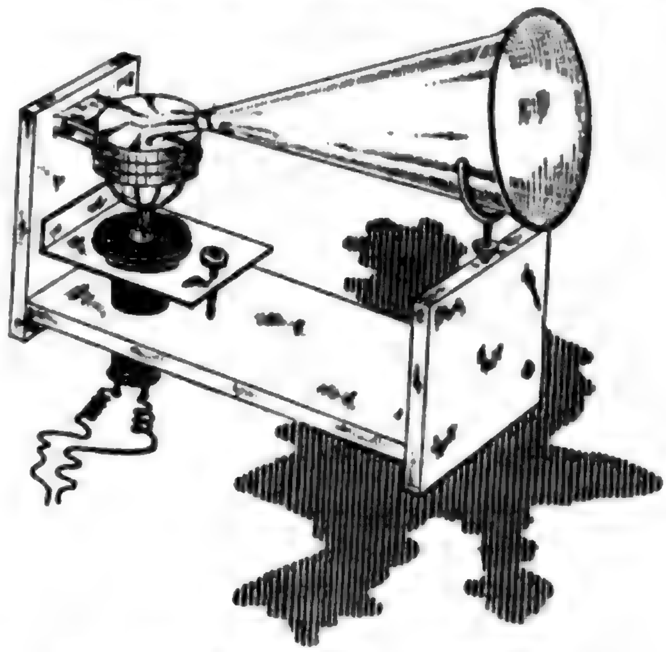
To make a battery solution, take a sufficient amount of the restored bichromate crystals and dissolve in water until the solution attains the strength that you usually make it. Then add the acid and your battery is ready for business again. Another mixture which is more quickly made, but less efficient, and one which I do not recommend, as it gives off a decidedly disagreeable odor, is to add chloride of lime to the used up solution. This must be done out of doors. The solution turns a greenish yellow, and a heavy deposit of sulphate of lime settles. Decant, and add fresh acid and you have a solution which will do for batteries which are kept in some barn or chemical laboratory, as the batteries will smell strongly of chlorine.

A Delicate Sound Amplifier for Telephone Receivers

TWO Danish inventors have patented in this country an interesting sound amplifier for telephone receivers. Though sound amplifiers are not new, the simplicity of this particular instrument has much to recommend it. Youthful investigators along electrical lines may want to make one like it with a view to learning something about the attractive field of sound and sound amplification.

The framework of the apparatus looks much like a small table book-rack. To the left standard a small board 4 or 5 in. square is nailed, and through a hole in the center of this the telephone receiver hangs, small end downward. It may even project through the base board of the "book-rack," but this does not matter, provided it clears the table beneath. A spring pushes up on the right-hand side of the receiver supporting-board, and through it a small set screw passes, so that the receiver's height can be slightly altered when necessary.

Near the top of the "book-rack's" left



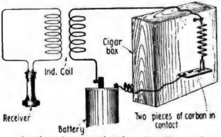
The telephone receiver mounted in a frame with a horn to make the amplifier

standard appears a hinged support for a sound box—this latter much resembling an ordinary metal pill box or other similar container. The horn is attached to the top of the soundbox, and across its bottom a membrane is stretched. A kind of a trunnion is attached to this membrane, terminating in the head of a pin or other small ball, which is intended to press against the diaphragm of the telephone receiver below. The several adjusting screws shown serve the purpose of adjusting the pressure of horn and sound box on the receiver diaphragm to give the best results.

Connected up with a telephone transmitter in the usual way or with a microphone, this type of apparatus will give unusual results. A microphone may be made by standing a cigar box upon end, and gluing a piece of carbon to the center of its bottom. Pressing on this, is another small piece of carbon, held up by a short length of coil spring made out of copper or other wire. The bottom of the cigar box acts as a sounding board, and if you talk against it, the carbons are vi-

brated sufficiently to act as a transmitter when connected in on the circuit as shown. Microphones may be made very sensitive, and, when combined with the sound-amplifying contrivance here described, should make exceedingly faint sounds audible.

The induction coil shown in the microphone circuit is not strictly necessary, but

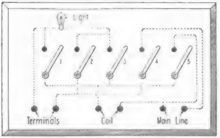


A microphone made of a cigar box and its wiring diagram to the induction coil

it will improve the operation of circuits. The primary (big-wire) side goes in the battery circuit, and the secondary (fine wire) side in that of the receiver. An induction coil of suitable size may be purchased from any telephone company.

Switchboard Constructed for Use in the Laboratory

THE illustration shows a simple combination of switches that can be used to flow a current of electricity in different strengths for making tests in a laboratory. The switches can be connected with the ordinary commercial line carrying 110 volts. Referring to the



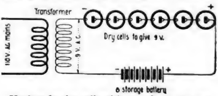
A combination of switches on a base for directing electric current for a laboratory

illustration, when 1, 4 and 5 switches are in contact, a straight current flows at the terminals. Switches 1 and 4 cuts in a series through the coil, and 3, 4 and 5 a series through the light. The switch 2 cuts the light into the circuit and 5 cuts the coil into the circuit.

A common arc light coil is connected to the terminals at the point marked coil and a 110-volt lamp at the place marked light.—T. I. DEKLE.

Alternating Current Charging Without Rectifier

IT is not absolutely necessary to have a rectifier with an alternating current for charging storage cells. Imagine that we have a 6-volt storage battery in need of charging and that the house mains provide current at 110 volts A. C. We hook in a bell transformer stepping down the voltage to nine volts as shown by the sketch, and then connect six ordinary dry-cells—new ones—in the secondary circuit, the dry cells being in series with the storage battery to be charged. It is es-



Hookup for dry cells with transformer to rectify alternating current for battery charging

sential to connect the carbon pole of the dry cell battery to the positive pole of the storage battery.

Now to show that the battery is actually being charged: Let us consider conditions when the direction of flow of the A. C. is the same as the direction of flow of the dry cells—for convenience we will call this direction positive. Our transformer gives us 9 volts in a positive direction; the dry cells another 9 positive, while the storage battery gives us negative 6. The algebraic sum or resultant voltage is plus 12.

Consider now the other or negative alternation. Our dry cells give us plus 9; our transformer minus 9 and our storage battery minus 6. Resultant, minus 6. In other words, on the positive or charging alternation, we have 12 volts acting to force current through the battery, while on the negative alternation we

have only 6 causing a discharge. The net result is a pulsating charging voltage of 6.

The more skeptical of us might think that all of the current effective in charging comes from the dry cells and that the alternating current is not effective. But if we connect the dry cells to the storage battery, we have 9 volts charging against 6 tending to discharge, giving us an effective charging potential of 3 volts or only half the value obtained with the alternating current arrangement.

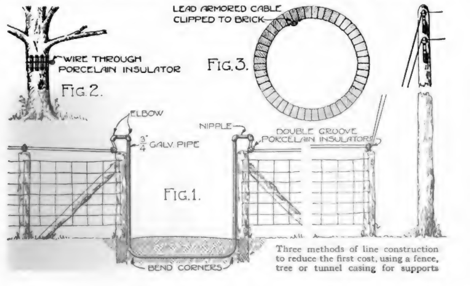
With the connections shown, the charging rate would be very low because of the high internal resistance of the batteries. Connecting several rows of dry cells in series parallel to provide the 9 volts would considerably hasten the charging. This method is recommended as a good one for use in connection with storage cells which have been sulphated, Bennett or Daniell cells taking the place of the dry batteries. The frequent alternations coupled with the low charging rate make for rapid correction of the sulphation.—E. F. HALLOCK.

Some Methods of Construction for Telephone Wires

AT the right side of the illustration Fig. 1 is shown a way of running a rural line along the top of a fence, the line wires being carried on insulators secured to the top of the fence posts. In the main part of Fig. 1 is shown how the wires are carried past a gate, and in Fig. 3 is shown how the wires are run through water-supply tunnels and large sewers; while Fig. 2 shows how large trees are sometimes used to support the wires and eliminate the cost of pole line construction.

When necessary to carry wires as shown in Figure 3, a regular lead-covered cable or an armored submarine cable is secured to the top of the tunnel or sewer by means of galvanized iron clips and brass screws which are driven into expansion shields. This method is generally used to supply service to a pump station or water intake which is situated out in the water some distance from the shore. When the water is quiet, as it is in a lake, the service is generally supplied by means of a regular submarine cable laid on the bottom of the lake; but when the cable must cross a swift-running river, it is advisable to put in the tunnel to prevent its being broken by the weight of water which would be constantly pressing against it.

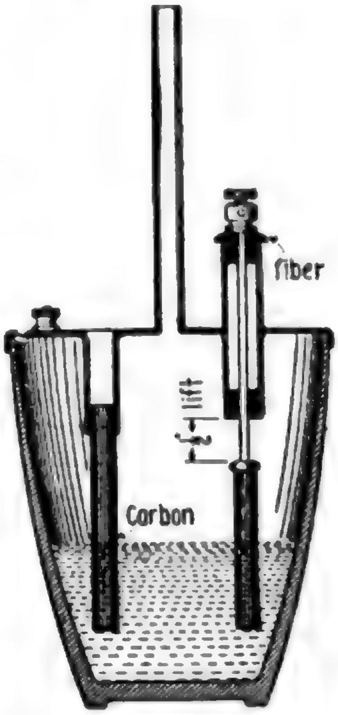
In Fig. 1 the ends of the pipe coming up from under the driveway are bent downward at the ends to prevent water from entering the pipe during rainstorms or from the dew and rotting the insulation from the wires.—GEORGE M. PETERSEN.



Three methods of line construction to reduce the first cost, using a fence, tree or tunnel casing for supports

An Electrically Heated Inhaler for Respiratory Troubles

SEVERAL home remedies for respiratory troubles are inhaled in the form of steam. The medicine is placed in boiling water, and the fumes are breathed through an inverted funnel. A much more satisfactory way of doing this, particularly at night, is to heat the fluid by electricity in the manner illustrated.



Jam jar fitted with necessary electrodes

The body of the apparatus consists of a cheap jam jar with a tin cover that fits on tightly. Two holes about the size of a lead-pencil are drilled, one in the center and one at the side, of the cover. A metal tube about 4 in. long is soldered over the central hole, and another piece of tubing about 2 in. long is slipped through the hole, near the side, and soldered in place with half its length extending upwards. Bush this tubing at the top and bottom with fiber or hard rubber, and have an ⅛-in. hole drilled through each bushing. A third piece of tubing 1 in. long is soldered on the underside of the cover diametrically opposite the 2-in. tube.

Remove the central carbons from two discarded flash-light batteries and thoroughly clean them. Remove the brass cap from one carbon and fit it tightly into the end of the shortest tube. Solder a rod or a large wire nail to the top of the brass cap on the other carbon. Slip this rod through the holes in the bushings, and cut it off after allowing ½ in. to project when the rod is raised as high as the carbon will permit. Finally solder a binding post or some sort of connector to the upper end of the rod. The lower ends of the carbons will now have to be trimmed off, so that when the cover is in place the stationary carbon will come within ⅛ in. of the bottom of the jar and the movable carbon will be at a similar distance when it is at its lowest position. After soldering a second binding post to the top of the tin cover, the inhaler is complete.

To test it, put in about ¾ in. of water, and connect it directly, without resistance, to the 110 volt current. Unless the water is unusually free from mineral salts, it should boil in one or two minutes. If it does not do this, add the slightest pinch of table salt. A steady stream of steam should now issue from the central tube, after which the adjustable carbon may be raised almost out of the liquid. Even though the temperature of the water rises gradually, there is no danger of breaking the glass. When everything is operating smoothly, drop the medicine down through the central tube with a medicine dropper.

It can readily be seen that with this apparatus the volume of the steam and the strength of the solution are always conveniently within control.

Ignition Hookup for Use on Automobile Circuits

ELECTRICAL ignition systems are generally operated on low voltages from primary batteries, storage cells, or small low pressure generators. The series-multiple connection shown in Fig. 1 is generally used.

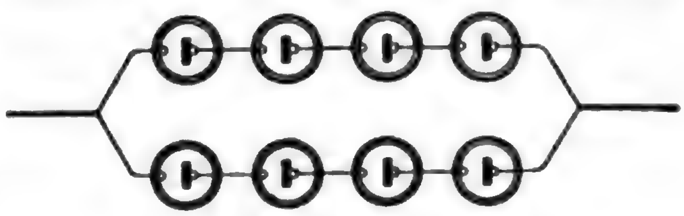


Fig. 1

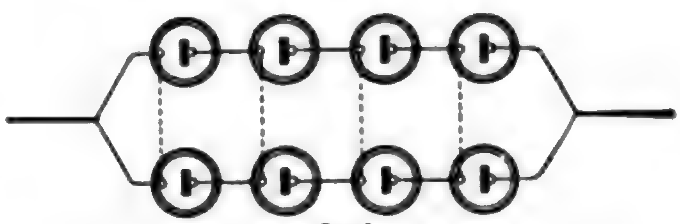


Fig. 2

A hookup to prevent a loose connection from rendering the entire series useless

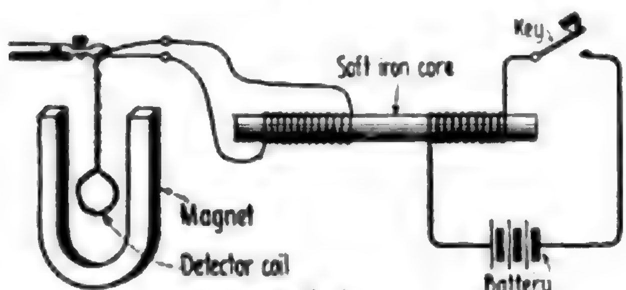
If additional cross-connections are made, as illustrated in Fig. 2, it will be found that a loose connection in one series of cells will not render the entire series useless.—PETER J. M. CLUTE.

Electrical Devices and How They Work

V.—Principles of the induction coil and transformer

By Peter J. M. Clute, B. E.

IF a coil of insulated wire is wound around an iron core, as shown in Fig. 1, and connected to a battery circuit, and if another coil is wrapped about the same core and its terminals connected to any current detector, as shown in the illustration, it will be found that when the key is closed, the deflection



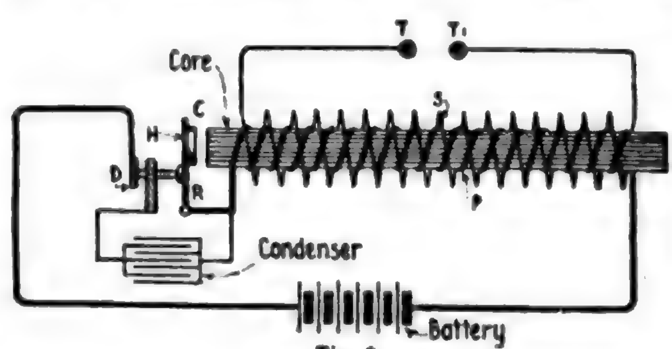
Illustrating the working of an induction coil and alternating current transformer

of the detector needle indicates a temporary current induced in one direction through the left coil. However, when the key is released, an equal but opposite deflection will be an indication of an equal induced current in the opposite direction.

This simple experiment illustrates the fundamental principle of the induction coil and the alternating-current transformer. The right coil which is connected to the source of current, is called the primary coil, and the left coil, in which current is induced, is the secondary coil. This coil causes lines of force to exist inside of the primary coil—in other words, magnetizes the space inside of left coil, which is the core about which both coils are wound—and thereby causes an induced current to flow in left coil. Demagnetizing the space inside of left coil also induces a current in the coil. This is in accordance with Lenz's Law, namely, that any change in the number of magnetic lines of force which thread through a coil induces a current in the coil.

If half of the turns of the secondary are unwrapped, the deflection when the circuit is opened or closed will be found to be about half as great as before. Since the resistance of the circuit has not changed, it can be deduced that the E. M. F. of the secondary is proportional to the number of turns of wire upon it. This results from the principle that the E. M. F. induced in any circuit is equal to the rate of cutting of lines of force by that circuit. All the lines produced by the primary and which pass through the core, cut all the secondary turns. If, therefore, there are twice as many turns in one case as in another, theoretically twice as many lines of force cut the circuit, and hence the E. M. F. is twice as great. If, then, it is desired to obtain a very high secondary voltage, it is only necessary to build the secondary coil of a very large number of turns of fine insulated wire.

The induction coil, shown diagrammatically in Fig. 2, consists of an iron core *C*, composed of a bundle of soft iron wires; a primary coil wrapped around this core and consisting of a small number of turns of coarse insulated copper wire, connected to the battery circuit through the contact-point at the end of the screw *D;* a secondary *S* surrounding the



A diagrammatic illustration of an induction coil with one wire coil on top of the other

primary is indicated, and consisting of a very large number of turns of fine copper wire, the terminals of which are *t* and *t'*; and an electromagnetic hammer *H*, or other arrangement for making and breaking the primary circuit.

When the primary is closed, the core becomes magnetized. Thereupon, the iron hammer *H* is drawn away by mag-

netic action from its contact with D and the current is thus suddenly stopped. This instantly demagnetizes the core and induces in the secondary an E. M. F., which is usually high enough to cause a spark to leap the gap between t and t'. As soon as the core is demagnetized, the

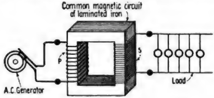


Fig. 3

Form of a transformer core that keeps the lines of force in a continuous iron path

spring R, supporting the hammer, restores contact with D and the operation is repeated. The condenser, shown in the diagram, is not an essential part of the coil; but when it is introduced, it is found that the length of the spark sent across the air gap is considerably increased.

The commercial transformer is a modified form of the induction coil. The essential difference is that the core in Fig. 3, instead of being straight, is bent into some other form such that the magnetic lines of force have a continuous iron path, instead of being obliged to push out into the air, as in the case of the induction coil. Furthermore, it is always an alternating instead of an intermittent direct current which is impressed on the primary P. Sending such a current through the primary is equivalent to

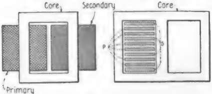


Fig. 4

Diagrammatic illustration of two general classes of transformers, a core and a shell type

magnetizing the core first in one direction, then demagnetizing it, then magnetizing it in the opposite direction, etc. The result of these changes in the magnetism of the coil is, of course, an induced alternating current in the secondary coil S.

If there are few turns in the primary and a large number in the secondary, the transformer is called a step-up transformer, because the voltage produced at the secondary terminals is greater than that impressed at the terminals of the primary, by the ratio of the number of turns of primary and secondary coils. Thus, an induction coil may be said to be of the step-up type. For some uses, however, transformers may be of the step-down type. For example, 2000 volts are impressed at the terminals of the primary, and a lower voltage, say 100 volts, is obtained at the secondary terminals. In such a case the primary will have 20 times as many turns as the secondary, and, we call it a 20 : 1 step-down transformer.

Assuming that the losses in the trans-

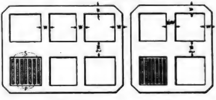


Fig. 5 Fig. 6

The usual arrangements of coils and core for a shell type polyphase transformer

former are so small as to be negligible, the same number of magnetic lines of force passes through both primary and secondary coils. Since the E. M. F.'s in the two coils are proportional to the number of lines of force multiplied by the number of turns in the coil, it follows that the E. M. F.'s are directly proportional to the number of turns of wire upon the two coils.

Transformers are divided into two general classes, namely, core transformers and shell transformers. These two types are illustrated diagrammatically in Fig. 4.

Transformers for two- or three-phase currents can be made by combining two or three single-phase transformers into one piece of apparatus. In certain cases, polyphase transformers are desirable, but general practice is to use two or three separate single-phase transformers for transforming polyphase currents. The usual arrangement of coils and core for

shell-type polyphase transformers is shown in Fig. 5 and 6. The three-phase type is equivalent to three single-phase transformers placed against one another. There are three distinct sets of coils, but the core forms a part common to all three. By combining the core in this way, a saving of iron is effected and the core loss slightly reduced.

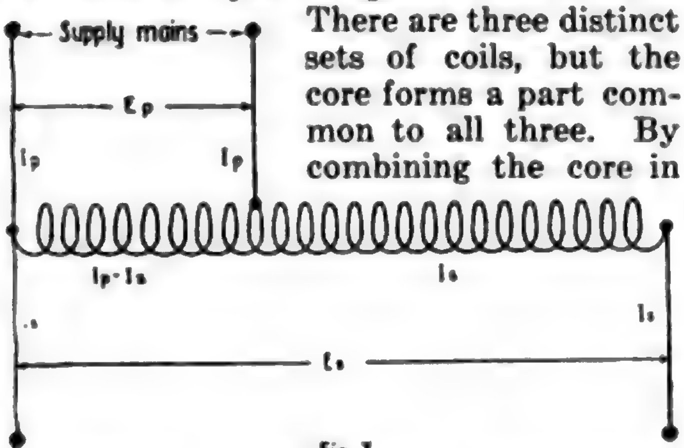
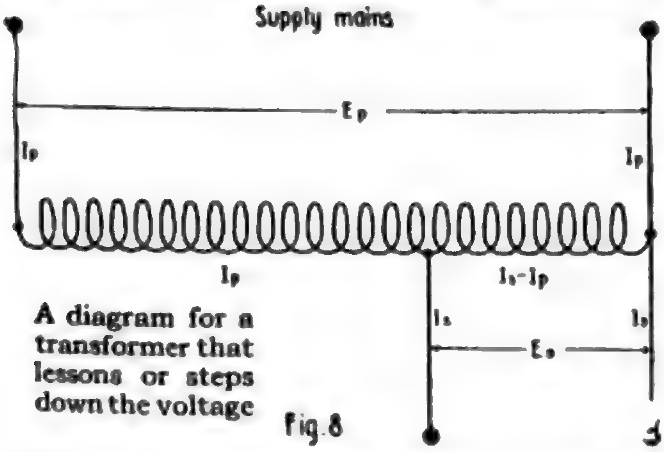


Fig. 7

A diagram for the winding of an autotransformer arranged to step up the voltage

A two-phase transformer gives but little saving over two single-phase ones, as is seen by reference to Fig. 6.

Another type of transformer often employed is the autotransformer. They differ from the ordinary type, in that they only transform part of the total power supplied to them. In addition, the primary and secondary coils are connected in series, instead of being entirely separated. In the autotransformer, power is partly transferred by direct electrical conduction from primary to secondary, and partly by means of the alternating field. In the ordinary transformer, the two coils are electrically separate, and neglecting losses, the total power supplied to primary is transferred to secondary through the medium of the alternating flux.



A diagram for a transformer that lessons or steps down the voltage

Fig. 8

In Fig. 7 is shown a diagram of the winding for an autotransformer, arranged to step up the voltage, and Fig. 8, a diagram of one for stepping down the voltage. In the former the high-voltage mains are attached to secondary, while in the latter they are connected to primary.

Referring to Fig. 7 and 8, Ep denotes the primary E. M. F.; Ip, primary current; Es, secondary voltage; and Is, secondary current. Whatever the winding arrangement may be, the rule of voltage transformation is the same as for transformers having two insulated windings. Thus, if Tp denotes the number of primary turns, and Ts of the secondary, then, $Ep : Es = Tp : Ts$.

Neglecting losses, primary input equals secondary output, or $Ep\ Ip = Es\ Is$. Whence, $Is = Tp\ Ip \div Ts$.

Thus, the secondary current in the autotransformer is equal to primary current multiplied by the ratio of primary to secondary turns.

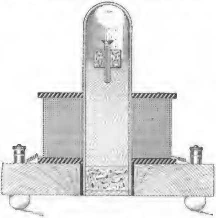
Here Is an Interesting and Artistic Electric Battery Tester

THE battery tester shown is designed to show the condition of electric batteries and will indicate roughly the amount of energy left in any cell. It is very easily constructed, and if the work is carefully done, the instrument will make a handsome and useful addition to any amateur's set of electrical appliances.

Procure a 4-in. test tube. These tubes come in different lengths and the longer the tube the higher the wire coil will be and the more wire will have to be used.

Having selected the tube, measure its outside diameter. Then get a piece of pine board ¾ in. thick and about 5 in. wide. Mark with dividers, a small circle in the center of the board. The circle should be ⅜ in. larger than the outside diameter of the test tube. Also mark a 4½-in. circle concentric to the small one. Bore a hole through the center circle, then cut the wood with a saw or knife as close to the line of the outside circle as possible and finish with sandpaper tacked on a block of wood. Get a small stove bolt or a machine screw and a cork. Punch a hole lengthwise through the center of the cork with a bradawl. Then put the stove bolt through the cork, using a screw driver for the purpose. Allow the bolt to extend more on the bottom than on the top of the cork. The bolt

should then be filed or cut so that the cork will just keep the bolt on the surface of a glass of water. Both the bolt and cork should then be dipped into hot melted paraffin wax so as to leave a thin coating on the surfaces. This keeps the



Current tester, consisting of test tube of water, cork and bolt, all surrounded by coil

cork from becoming saturated with water and also prevents the bolt from rusting.

Now take the test tube and tie it in an upright position to any convenient object. The round end should face toward the bottom. Fill the tube two-thirds full of water and put the cork with its bolt in it. Get a cork of sufficient size to fit the open end of the tube. Dip the cork in shellac, varnish it, then drive it into the tube, so that the side of the tube projects about 1/8 in. above the top of the cork. Let the shellacked cork dry, then fill up the space between the top of the cork and the edges of the tube with plaster of paris or cement—the latter preferred—making it level with the edges of the tube. When it has hardened, take a piece of emery paper and roughen the glass on the sides of the tube for about 1/2 in. from the end. This is to enable the cement to grip the tube tighter when it is fastened to the base board. Place the base of the instrument on a level surface and put the tube, corked end facing downwards, in the center of the small hole, the end of tube to be flush with the bottom of the base. Then fill the cavity between the sides of the base [illegible] with cement, keeping the tube in an upright position until the cement hardens.

The flange holding coil is made from cigar-box wood or other thin material. Nothing is to be gained by making the coil more than three times the diameter of the test tube; that is, if the outside diameter of the tube is 1 in., the total diameter of the coil including the tube will be 3 in. In other words, there will be 1 in. on each side of the tube. Measure the outside diameter of the tube, then mark on the board a circle of the required size and also mark with the dividers, a circle for the outside diameter. If a 1-in. tube is used, the diameter of the flange should be 3 1/4 in. wide, the 1/4 in. oversize being left to extend over the wire coil, as will be seen in the sectional view of the battery tester. Put the wooden flange on the test tube and slide it down to the center (it should fit the tube as tightly as possible), then glue it in place and let it dry. Get 1/2 lb. of No. 20 double cotton covered magnet wire and wind a sufficient amount of it on the spool to nearly fill it up, but allow the top flange of the spool to project 1/8 in. on each side of the wire.

In winding the wire, start and finish at the bottom, leaving 6 in. of wire on each side of the spool to connect the magnet with the binding posts, there being one of the latter on each side of the coil. Scrape the insulation off of the connecting wires and insert it under each binding post. The wood work should be enameled so as to make an attractive instrument. The enamel should also be put on the bottom and over the plaster of paris or cement seal and the joints where the tube is flush with the base. Four brass tacks spaced at equal distances should be placed on the bottom of the base. The test tube is then ready for use.

Connect a wire from the zinc of the battery to one binding post and the carbon wire to the other. The cork and bolt will then dip and rise as the circuit is closed and opened. The stronger the battery is, the quicker and deeper the bolt will sink. If the battery is nearly exhausted, the bolt will merely move about on the surface. A very artistic tester can be made by enameling the base of the tester red; coloring the spool flange black, the wire coil green, and the cork and bolt black.

Wireless Work in Wartime

X.—The Non-Synchronous Gap Radio Transmitter

By John V. L. Hogan

HAVING taken up, in the previous article, the general operation of the spark gap and primary oscillation circuit of a typical radio sending station, further and more specific types of spark gap may now be considered. In the illustration Fig. 38, printed last month, was shown a simple fixed air-cooled gap; and

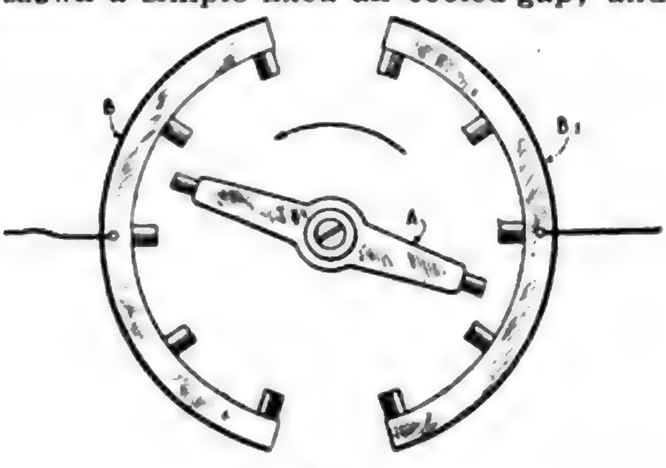


Fig. 39

An old type of a rotary spark gap which has been in general use for some time for wireless

the accompanying Fig. 39 shows a type of rotary spark gap which has had wide use. This consists of a rotating conducting arm *A*, having spark electrodes on both ends and mounted upon a driving shaft so that it may spin between two semi-circular frames *B*, *B*. Supported on the frames are a number (in this instance ten) of fixed, equally-spaced electrodes. The five on one frame are connected together and act as one terminal of the spark gap; the other five form the other terminal, being connected together in the same way. The length of the studs and the separation between them is so chosen that when the rotating arm is almost directly in line with any one pair there will be only two short spark gaps in the circuit. If at this time the transformer (and condenser) voltage is near its maximum, sparks will pass and the condenser will discharge with oscillations, as previously explained. If the rotating arm has passed out from a position almost directly between two stationary studs, however, not even the maximum secondary potential of the transformer can force a spark to jump.

The Disk Rotary Gap

Another type of rotary spark gap is shown in Fig. 40. Here there are two stationary terminals *D* and *E*, and between these there rotates a spoked wheel *F*. Each spoke has a spark gap tip *G* at its outer end; the length of the spokes and their distance apart is selected so that sparks can pass only when they are almost directly in line with the stationary electrodes. It is evident that these two types of rotary spark gap have much in common; in both of them the gap length is continually changing, and in both the gap is cooled and kept clear of conducting gases by the air circulation stirred up by the rotating member.

There are two general ways of using the rotary spark gaps. The gap of Fig. 39 is generally used according to one of these, the "non-synchronous" method, and has consequently come to be known as the non-synchronous rotary gap. The second type, of Fig. 40, has had its widest use according to the second or "synchronous" method, and is therefore often called the synchronous rotary gap. Neither of these names is strictly correct, however,

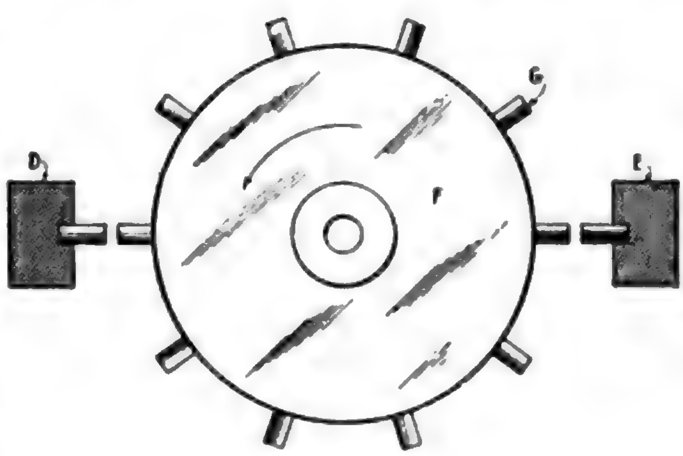


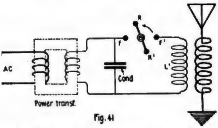
Fig. 40

The second type or synchronous method is usually called the synchronous spark gap

since there is no reason why either gap should not be used according to either the synchronous or non-synchronous method. This will appear from an examination of the two types of operation.

Non-Synchronous Operation

Taking up the non-synchronous discharge first, let us imagine that the rotating part of either gap is revolved by a direct current motor and that its speed of

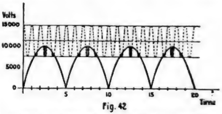


A diagram of a radio transmitter with a rotary spark gap interposed in the apparatus

rotation has no particular relation to the alternating current supplied to the power transformer in Fig. 41. As the secondary of the transformer charges the condenser, the spark-gap rotating electrodes *R, R,* are constantly moving toward or away from the fixed electrodes *F, F.* If the instant of maximum potential of the transformer should occur while the spark gap contacts are widely separated, no spark would pass and the condenser would discharge back into the transformer secondary on the next half cycle of applied power. If, on the other hand, the spark gap electrodes were quite near together when maximum potential was reached, a spark would pass and a group of radio frequency oscillating currents would be produced in the primary circuit. When the spark gap rotor is driven independently of the applied alternating current power, i.e., non-synchronously, it is evident that the time a spark will pass (and, in fact, whether or not a spark will pass at all) depends entirely upon chance. The only way to be sure that a spark will pass for each half cycle of alternating current applied to the power transformer is to increase the speed or number of electrodes of the rotary gap so that at least one opportunity for sparking will exist near the maximum voltage portion of each half-cycle. In commercial practice this has usually been accomplished by running the spark gap at a speed which corresponds to approximately 600 sparks (or, more strictly, "opportunities to spark") per second when the supply current is of 60 cycles per second frequency. Thus in each half-cycle of secondary voltage there are five instants at which the condenser might discharge across the spark gap, provided only that at each of these times the condenser voltage is higher than the minimum required to break across the shortest spark gap.

How the Condenser Discharge Time Is Varied

How the adjustment of the gap affects the times of sparking may easily be seen by studying Fig. 42. Here the solid curve represents the numerical potential value of the secondary condenser charge, as it is produced by the power transformer and without allowing for effects of withdrawing energy by the spark discharge. The dashed curve above represents the breakdown potentials of the rotating spark gap, and both are drawn for the same successive instants of time. The divisions along the horizontal axis represent time intervals of 1/600 second, and consequently ten of them are contained in two half-cycles or one complete cycle of audio-frequency voltage at 60 cycles per second. The voltage curves are all plotted above the axis, since in this case we are concerned only with the numerical value of the voltage and not at all with its direction—the spark gap will break



Curves showing the operation of the non-synchronous spark gap for a wireless set

down whenever the potential rises above a certain approximate value, substantially without regard to the direction of potential stress. The voltage is assumed to vary from zero to ten thousand.

Continuing with Fig. 42, the upper dashed curve may be understood by imagining the successive separations be-

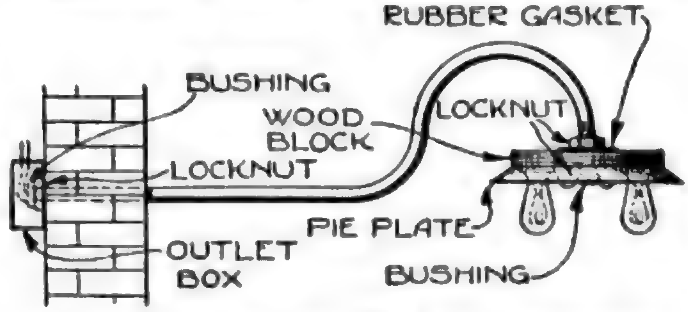
tween the rotating and fixed electrodes of the rotary gap. If the studs are set back so that when the gap is the shortest (i.e., when the electrodes are exactly in line) a voltage of 7,500 is required to cause a spark to jump, and if the design is such that a potential of 15,000 volts would force a spark across even when the electrodes are farthest apart (the moving studs exactly half-way between the fixed), the conditions illustrated in Fig. 42 will be had. The spark gap is supposed to have the number of studs and the speed chosen so that the electrodes approach and recede 600 times per second. The illustration Fig. 42 shows roughly what will happen in four half-cycles under these conditions. The first time the gap becomes closest there will not be enough potential to break it down, so the spark will be missed. The second time will produce a spark, since the secondary condenser will just have reached 7,500 volts. The third spark will pass, as will the fourth. These are indicated by shaded portions where the two voltage curves overlap. The fifth and sixth sparking opportunities will be missed, because the condenser voltage will in neither case be high enough to break across the minimum gap length. At the seventh, eighth and ninth opportunity sparks will occur, and the tenth and eleventh will miss. The twelfth, thirteenth and fourteenth will pass, but the fifteenth and sixteenth will be lost. Thus it is seen that there will be three sparks in each half-cycle, at the distance represented by 1/600 second of time, and that between each group of three sparks there will be an idle interval of 1/200 (3/600) second. If the sparking opportunities do not occur at exactly 1/600 second separation, but slightly less often, there will be two sparks in some half-cycles and three in others.

This will give a fairly complete idea of the rotary gap operating upon the non-synchronous principle. You should go over the details of this type of non-synchronous gap operations until you have firmly in mind the relations of voltage and gap length. The effect of changing various adjustments will be treated next month, when the quenched and rotary synchronous gaps will also be described.

(*To be continued.*)

How to Make an Efficient Weather-Proof Goose-Neck

A VERY efficient weather-proof goose-neck wall bracket can be easily constructed as shown in the illustration. It consists of a piece of ½-in. conduit bent

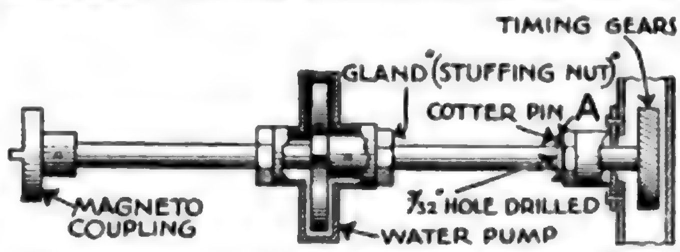


A conduit bent and fitted with pie-plate reflector to make a weather-proof goose-neck

in the shape shown and fastened into the wall with a locknut. The outer end has a wood block or disk attached with a locknut and rubber gasket. On the under side of this disk is an inverted pie plate to which the lamp sockets are securely attached.—CHRIS. BACH, JR.

A Temporary Repair for a Slipping Magneto Shaft

ABOUT the most annoying mishap a driver has to contend with on the road is that of a magneto shaft slipping endways so that the gears will be out of mesh. One cause of this trouble is the pump wheel shearing its pin and allowing the shaft to slip endways and out of mesh with the gears. In order to take the pump off and make the repair it is necessary to remove the starter, and this is entirely too big a job to do on the road.

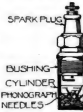


Placing a cotter in a magneto shaft to keep it from shifting endways out of gear mesh

The repair may be made in a temporary manner as shown in the illustration. A hole drilled through the shaft just in front of the stuffing box, as shown at *A*, provides a way for holding the shaft with a cotter. It is then only necessary to time the distributor, and the engine runs the same as before.—P. P. AVERY.

Cleaning Spark-Plugs with Phonograph Needles

THE usual way to clean spark-plugs is to take them apart and scrub them with a brush after scraping them with a knife. An easier and quicker method is here described. Secure a small cylinder open at one end, into which is fitted a bushing with threads corresponding to those on the ends of the plugs. After filling the cylinder about half full of gasoline, throw in a dozen or more old phonograph needles, then screw the plug in the cylinder. After giving it a good shaking, remove the plug. The end will be thoroughly cleaned, more thoroughly than if it were scrubbed and scraped in the usual way.—PETER J. M. CLUTE.

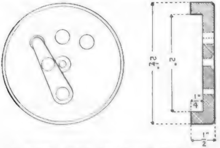


Phonograph needles remove carbon deposit

A Good Permanent Base for Small Battery Switches

NO doubt many an experimenter and many a student in an electrical school has had the misfortune to break the frail wood base of a battery switch. A switch made like the accompanying illustration will last almost indefinitely.

Take a piece of ½-in. fiber, 2½-in. square and place it in the chuck of a small lathe, and recess the bottom 2 in. in diameter and ¼ in. deep, as shown in the sketch. Before removing the fiber from the chuck, drill a 3/16-in. hole in the center, remove it from the chuck and put a 3/16-in. bolt into the center hole and lock it with a nut of the same size. The bolt is then put into the chuck, and the outside is turned round.


A battery switch base turned from fiber makes a substantial mounting for the parts

The radius of the switch lever and the size and the distance apart of the switch point holes must be determined from the style of switch from which the parts are taken.—WALTER B. WEBER.

This Lighthouse Sends Radio Fog Warning Far Out to Sea

POINT JUDITH LIGHT, near Newport, R. I., is now equipped with a radiophone fog-warning machine. The words "Point Judith Light!" are repeated every five seconds and can be heard anywhere within a radius of about eight miles. After every third warning the words "You are getting closer; keep off!" are sent out. These can be heard about two miles away.

Wave lengths keep changing continuously between 550 and 650 meters, in order that operators on passing ships may be more likely to hear the messages even if at the moment they may not be tuned exactly to a standard wave-length. The system is likely to be improved at intervals. All lighthouses could profitably employ such a contrivance if it works out well in practice.

Opera Hat with Enclosed Electric Light for a Sign

FROM a French inventor comes an advertising sign in which an opera hat is its housing. The sides of the hat are cut so that letters are removed that spell out the words of the sign. These letter holes are covered over with a thin light fabric of the same color as the hat. When unlighted the letters remain invisible, but with one or more battery lamps placed inside and lighted, the hat becomes a conspicuous advertisement. The batteries may be carried in the pocket and wired under the coat to the neck and up to the hat over the hair on the back of the head. The current can be flashed on and off with a switch in the coat pocket. This is a real novelty in advertising signs and one which would be sure to attract attention.

American Library Association

Library War Service

GENERAL DIRECTOR
HERBERT PUTNAM
LIBRARIAN OF CONGRESS

EXECUTIVE SECRETARY
GEORGE B. UTLEY

HEADQUARTERS
THE LIBRARY OF CONGRESS
WASHINGTON, D. C.

ASSISTANTS TO THE DIRECTOR
CARL H. MILAM
JOSEPH L. WHEELER

DISBURSING OFFICER
WILLIAM L. BROWN

March 18, 1918

Editor, "Popular Science Monthly"
239 Fourth Avenue
New York, N. Y.

Dear Sir:

We are just in receipt of a communication signed by the Camp Librarians at Camps MacArthur, Logan, Bowie, Travis, Pike, and Doniphan, stating that there is in these camps a demand for "Popular Science Monthly", which is far in excess of the copies received through the Burleson "one-cent" privilege. It is very desirable that more copies of "Popular Science Monthly" reach them promptly from the original subscribers. On behalf of the thousands of reading men whom they represent, they ask us "in some emphatic way" to place this matter before your subscribers and see if it is possible to get more copies of this magazine into the postoffice under the Burleson Act. The need is urgent.

There is an over-supply of some magazines, but an under-supply of yours. We are of the opinion that this need of a supply exists at many other camps, and we therefore hasten to call this matter to your attention.

Very truly yours,

Joseph L. Wheeler

Assistant to the Director

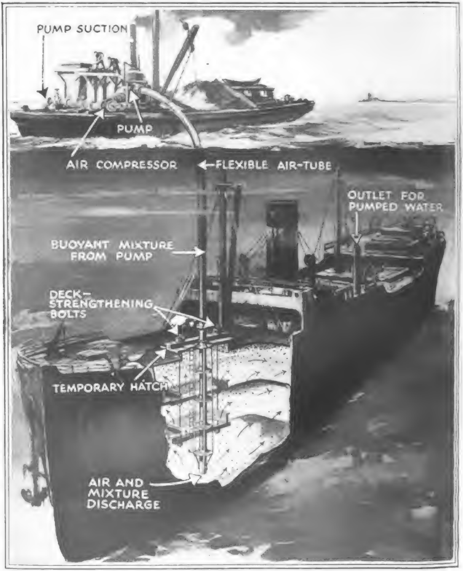
JLW:EJW

Readers of the Popular Science Monthly:-

We receive letters such as this all the time. Please help the Camp Librarians to make it easier for our boys "over here" as well as "over there". When you have read your Popular Science Monthly, put a one cent stamp on it and drop it into the nearest post-office or mail box.

Editors of the Popular Science Monthly.

Salvaging Ships Sunk by Submarines



Raising a Hull by Pumping a Buoyant Mixture Into It

Salvage ships on the surface and section of sunken ship of usual cargo-carrying type below. Connection is made, extending through all three hatchways of the ship to its hold, by a flexible tube secured within another flexible tube and continued within a metal pipe coupled to the latter. The metal pipe is secured to a temporary hatch-cover, with manhole for the up- [illegible]chway, and carries a ladder and working plat- [illegible] divers. The entire construction is further [illegible] brace rods wherever they are needed. The inner flexible tube is connected with a centrifugal pump in the salvage ship. A derrick supports the tubing. A suction pipe with a cut-off valve or seacock leads from the centrifugal pump to the open sea. It connects with a hopper that receives the buoyant material. The paraffin comes through a pipe from the paraffin tank where it is kept liquid and heated by a steam coil connected with the ship's boiler. An air pump is connected by a pipe to a space between the outer and the inner flexible tubing

Popular Science Monthly

225 West Thirty-ninth Street, New York City

Vol. 92
No. 6

June, 1918

$1.50
Annually

Raising a Sunken Ship with Cork

A way of salving valuable ships which have been torpedoed

By Simon Lake

SINCE the outbreak of the war several thousand ships, ranging in displacement from a few tons to thousands of tons, have been sunk by submarines, mines or shell fire. The loss of the ships and of their valuable cargoes is so great that it is keenly felt by the nations principally concerned. Long before the German submarine adopted the present policy of sinking all ships found within prescribed zones and thereby involving the United States in the war, I invented a method of salving vessels which may be applied after the treaty of peace is signed. Many of the ships sent to the bottom by the Germans are lost beyond all hope of recovery. They have been either too severely damaged by the explosions of mines or torpedoes, or they lie at depths too great to be reached by divers.

But enough have found a resting place in water shallow enough to justify the use of the invention I am about to describe.

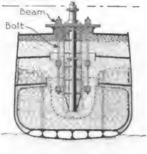
Mr. Simon Lake, the author of this article, is one of the pioneers in the development of the submarine. His reputation as an inventor and builder of submarines and his vast experience as an adviser on submarine questions to the United States Government as well as to the leading European Powers entitle the ingenious suggestions contained in this article to most careful consideration

I do not believe strongly in pumping water out of a sunken ship, because it is nearly impossible to close all openings and prevent other water from running in to take its place. Then if they are at any considerable depth the water pressure will crush in their decks. To place chains under the ship and attach them to pontoons, from which the water is thereafter pumped out, is a ticklish job unless the waters are quiet and the sea bottom sandy. The use of many small air bags or casks placed under the decks by divers is costly and suitable only for small wooden vessels.

I suggest that the water be driven from the interior of the ship by forcing buoyant material in, which may be accomplished by centrifugal pumps pumping into the sunken vessel water mixed with cork or heated paraffin or both. The buoyancy of these materials eventually lifts the vessel, and the materials are gathered and used over again. As paraffin hardens when cooled, it does not escape through small rents or fissures in the decks; on the contrary, it tends to close them. Holes in the bottom of the ship do not interfere with this process. The buoyant materials, after being forced in, tend to spread in a gradually hardening and expanding layer under the decks, strengthen-

ing and preventing them from collapsing or lifting. If weakness is suspected or reported by the divers, a mixture of paraffin and small blocks of cork is used in preference to either of the materials alone, as it forms a stronger and more binding mass, extending as a beam from one side of the ship to the other. After the upper decks have been sealed in this manner, air can be pumped into the vessel to force more water out, either through a pipe provided for this purpose or through breaks in the bottom. In the case of torpedoed ships with large openings in the sides, considerable preliminary repair work by divers may be necessary to close the upper portions of the rents or to construct bulkheads extending far enough down.

The operation is readily understood by reference to the description under the accompanying illustration. When the seacock is opened, water rises in the hopper to the level of the sea. When now the centrifugal pump is started it pumps water into the sunken vessel. If there are no holes in it, an outlet for the surplus water is supplied by means of a pipe raised in the ship's bottom. The buoyant material—small blocks of cork or balsa wood boiled in paraffin—is now dumped into the hopper till its weight forces it to mix with the inflowing water, and it is thereby taken into the pump and forced down through the piping. Released at the lower end of the inner pipe it rises, but the water with which it is mixed, seeking the outlet provided for it in the other hatch, produces currents carrying the cork along, so that eventually it reaches all parts of the ship, rising the while against the decks. When a sufficient amount of this buoyant material has taken the place of water, the ship rises.



How Decks and Hatches Are Secured

The upper deck of a sunken ship may be strengthened by hardened deposits of cork and paraffin under it. To secure the hatches, heavy beams are weighted and lowered into the hold and placed in position by divers. Next the weights are removed and the buoyancy of the beams holds them in position. Bolts are lowered and connected with the beams. Then a second set of beams is placed on top of the hatch and connected with the tie-bolts. This arrangement effectually distributes the strain on any one deck to all the decks of the ship

If the ship is too weak from prolonged corrosive action of the water, and the decks liable to lift, heated paraffin is run into the hopper with the cork. To prevent it from cooling and hardening too soon, air is pumped into the space between the inner and the outer tubing. Some air is allowed to be forced into the hold together with the cork and paraffin and helps to carry these substances toward leaks and sealing them.

Lighting Up East India—How America Helps

INDIA is making slow but steady progress in introducing more modern lighting methods. All public lighting in the large cities of India is by electricity; but in smaller cities the methods of lighting, public as well as private, are still very primitive. The use of illuminating gas is extremely restricted and lamps in which petroleum or vegetable oils are burned are used to some extent, though not generally.

For native festivals—and there are a great many of these—large kerosene lamps of an elaborate pattern are much used. They are known in many localities as "Washington Lights" and were originally brought to India from the United States. At various religious processions and especially at wedding processions as many as twenty or thirty of these lamps are carried on the heads of bearers who are engaged for the occasion and paid a fixed fee.

These lamps are high-pressure kerosene lamps constructed upon the principle of the kerosene torches used in the United States. The light is protected by a mica chimney and is very brilliant. Colored globes are sometimes used. These lamps are no longer imported from the United States but are manufactured in Bombay. The "Bombay Lights" cost about five dollars or six dollars, while the imported kind can not be bought for less than sixty-five dollars apiece.

The Martyr Pigeon of the British Navy. He Saved Four Men

"WHERE in the world are we?" roars one of the observers in a huge biplane which is trying to make home after a run into a fog-bank, feared by all airmen. The raw biting air wraps around the four men in the machine, and nothing can be seen but blinding billows of fog. Darkness descends and they are still lost. There is a falter in the hitherto steady roar of the engine. "She's starting to miss!" yells one of the observers. The pilot silently adjusts his spark and throttle. She picks up, but the rhythm is again broken, worse than before. All faces are tense and nerves are tightening. Lost! Over the sea! Desperately the pilot struggles to keep the engine running, but with a final crackle she peters out and the machine starts to glide down.

She lands with a splash in the water. She does not sink for she is fitted with hydroplane floats. The men cling to the machine. To repair her is hopeless in a running sea. "The pigeons! The pigeons!" a man yells. Here is a bare hope. After a struggle they manage to attach the message to a pigeon's leg and release him. The little messenger fights his way through the howling gale towards the place where instinct tells him his home lies. The valiant little heart never falters. At last he feebly flutters into his cote in England. It is his last effort though. His work is done, and his strength is spent. The attendant picks him up—dead.

The rescue of the aviators after great sufferings is another story, just as true and exciting as this. Suffice it to say that they *were* rescued. The stuffed body of the martyr pigeon is preserved in a glass case in honor of his great deed; and in the hearts of those he saved he has another monument built of gratitude.

A winged messenger which saved the lives of four men at the cost of its own

Bomb-inspector Eagan examining a deadly contrivance recently found in New York

You've Probably Escaped This Way of Being "Blown Up"

A BOMB containing enough dynamite to demolish the walls of the building in which he lived was recently found by a resident of the Italian section of New York city. At first glance the object seemed harmless enough. It was apparently a can, about ten inches in length and three inches square, used to contain olive oil. But attached to the can was a fuse at sight of which the discoverer hurried to the policeman on post near by, and soon afterward Owen Eagan, bomb expert of New York, took charge of the death-dealing instrument.

He found inside the can about a pound and a half of dynamite, placed on a base of cement to make the bomb more effective. The fuse was about two and a half feet in length, and was connected with fulminate-of-mercury caps designed to explode the dynamite. Fortunately the fuse was not burning when the bomb was discovered.

The principle of the snowshoe applied in walking on mud when digging shellfish

Shoes that Prevent the Wearer from Being "Stuck in the Mud"

ALONG certain portions of the French coast there are extensive flats of mud that the tide leaves uncovered when it recedes. While these are by no means beautiful, they yet provide the habitants with profitable employment in addition to the usual fishing operations by reason of the various mollusks that live in the mud. To obtain these the fishermen use long-handled rakes and forks, with which to dig the shell-fish out of the mud. However, the mud itself forms a serious obstacle. It is so soft that a man sinks into it and cannot move about with ease. Hence, peculiar wooden shoes are worn which act in the same manner as a snowshoe. They support the weight by distributing it over a greater area. Similar devices are in use on the east coast of England, where they are called "pattens." The picture shows how simple the shoes are in construction.

The Process of Making Parchment Paper

BY immersing paper for a short time in a fairly concentrated solution of sulphuric acid, the cellulose is converted into a gelatinous mass which fills up the pores of the paper, and, on being thoroughly washed, the paper is found to be parchmentized, or converted into a non-porous material resembling parchment (prepared skin of the sheep or she-goat). According to Alexander Findlay's "Chemistry in the Service of Man" (Longmans, Green & Co.) such parchment paper can also be prepared by immersing paper in a solution of zinc chloride; and by compressing together a number of sheets of such parchment paper, the compressed fiber, or "hard fiber," so largely used in the manufacture of trunks and as an insulating material, is obtained.

Raising a Ghost to Prevent Waste of Commodities

HOW would *you* like to have the ghosts of your misdeeds and the carcasses of your victims resuscitated for your benefit? This is what a great Pittsburg electrical company did a short time ago as a gentle reminder to its employees that we are at war.

A storage-battery truck was used for an exhibit. On it was accusingly arranged the material rescued from waste-boxes during one day. This included scraps of food from employees' lunches, and material belonging to the company. The truck was run around the shop, a notice calling attention to what it represented.

The company's officials estimated that from thirty-five to fifty dollars' worth of food was wasted daily, and hundreds of dollars' worth of manufacturing material. This would be a total loss to the company if it were not for the efforts of a staff of "recovery men."

An exhibit of wastefulness which is doubly reprehensible now when economy is a duty

Hanging Flower-Gardens in Old Gas-Lamps

OUT on Blair Avenue, in a residential section of Cincinnati, a flower-lover had a happy inspiration. There had been a change made in the street lamps used. The older-style gas-lamps were discarded, the glass globes were removed, and only the old poles and the lamp-frames were left.

"Good enough!" thought the flower-lover.

Down in his cellar there was some old window-screening. It was the work of a moment to rip the screen itself from the frame, take the family ladder to the sidewalk, and wrap and bend the screen to the prongs of the lamp-frame.

Soil from the yard; seeds from the war-garden; water when needed—and lo, in a very short time each lamp-post had its hanging garden.

An old gas-lamp filled with flowering plants in a Cincinnati street

A Breath-Guard—But Not the Kind You Mean

A MAN'S breath is often a betrayer of secrets. He may have been out late, sitting up with a sick friend, but when he reaches home his loving wife at once opens up her battery of reproaches.

Now comes the news that two inventors in Osceola, Arkansas, have jointly invented a breath-guard of a new pattern. It is said to be efficient, but not in the manner you were thinking of. It is intended to protect dentists, barbers, and physicians, from inhaling the germ-laden breath of their patients or patrons. It consists of a small, curved shield of glass placed so as to cover the nostrils and held in position by a spring clip gripping the partition wall of the nose on the inside. Many diseases are directly communicated through the inhalation of tainted air, and a device of this kind should be a boon to professional people who are compelled, by the nature of their duties, to be in close proximity to those whom they serve. The *patrons* of some barbers may also need it.

No matter how strong your breath the barber is safe. The shield shown protects him

Old Age Is Not a Matter of Years, But of Recuperative Power

IT would seem that the phenomenon of growing old has really nothing to do with the number of years that an individual has lived, but depends principally on the extent to which he has conserved his recuperative powers. The human body wears out in two ways, i.e., either by long-continued use or by long-continued disuse. In the former case it is like bending a wire back and forth in one place until it breaks, and in the second it is the atrophy of organs or functions through disuse. The only way to stave off old age is to eliminate all forms of abuse and live as Nature intended us to live.

Cannon May Kill at Ranges of Five and Ten Miles; Machine Guns May Fire Six Hundred Shots in One

Disarm!

Jiu-jitsu wrestling methods are introduced in warding off a bayonet attack. While these boys are here fighting as friends, there is a background picture in their minds which adds zest and "pep" to their struggle

Wringing His Neck

Trying to disarm and disable his opponent by throwing him with a neck hold. What these boys must face "over there" lends realism to their work

The One-Step

A good grip on a man's toe is by no means a hold to be "sneezed" at. These two troopers are doing strenuous work—offensive as well as defensive

A Class in Hand-Grenade Throwing

No, they are not training to become baseball pitchers! They are trying to toss cement balls into an "enemy" trench indicated by chalk lines. When they get across the ocean they will use deadlier missiles calculated to put a permanent quietus on some of their adversaries. This squad is the "kindergarten" class in bomb-throwing

Minute; But the Hand-to-Hand Struggle Still Lives in Modern War —and Our Boys Must be Masters of the Art

© Photos by Edwin [illegible]

All's Fair in * * * * and War

The deadly grip this man has upon his adversary may well prove the undoing of a Boche who is unversed in the gentle art of self-defense, as taught by the [illegible] of Japan and adopted by our "Sammies"

A Strenuous Game

A strangle hold calculated to break an adversary's neck and prevent him from driving home that deadly bayonet. There is earnestness in the face of the unarmed fighter. You can see that his whole soul is in his work, for success or failure may mean all the difference between life and death to him some day—and to the Boche who opposes him

A Dash to the Dressing Station

Picking up a man lying prone on the ground and running with him on your back for fifty yards is not as easy as it looks to these huskies. It is all in the day's work for the training "Sammies." One man picks up the "wounded comrade" and runs with him for that distance, when he deposits him on the ground. Another make the return trip

Woodenware and Hardware Hats the

Since we men editors are not masters of millinery lingo, the best that we can do is to describe this thing at the left as an ultra-chic and daring creation with a wooden bowl foundation trimmed with two butter paddles rampant and two dozen mustard spoons couchant

Chaste sport hat woven of electric light wires, trimmed with a bright band of lamp sockets and a cascade of tassels

Stunning bonnet of military effect. The foundation is a wire cheese-hood and it is trimmed with wire-screen and sink-brush

Photos © Underwood and Underwood

A p[illegible] this ultra smart
chap[illegible] an basin body is
tas[illegible] of a big bow

Very Latest Thing in Fashion

Severely plain are the lines of this coquettish sailor hat made on a foundation of gas-hose and daintily trimmed with a wire aigrette and imitation insects

Right cunning is this natty tailor-made hat with rubber-mat brim and ice-bag crown, trimmed with a band of gas-pipe and a stunning loop of the same material

How could a feminine heart resist this ultra charming creation of artistic design? The straight brim is made from a pot-cover, the crown of coiled rope, and the foundation is a cake-pan strikingly trimmed with sandpaper triangles and a rope rosette

"Cootie" Annihilators for General Pershing's Army

A train of modern sterilizing and fumigating wagons on its way to Uncle Sam's boys on the battle front in France. This up-to-date apparatus was designed by Dr. Leon L. Watters, of New York, and Colonel F. H. Hartsock of the United States Medical Corps

This apparatus will wage a war of extermination on the soldier's enemy, the "cootie." It consists of a high-pressure steam boiler in which the clothing of forty men can be disinfected in as many minutes. The "cooties," or trench lice, are typhus-carriers, and must be destroyed. Even aside from this they are uncongenial companions

Helping the Soldier Boys to Keep Themselves Clean by Means of a 22 Horse-Power Portable Laundry

A stack of army coats that have been laundered, pressed and made ready for distribution

A busy day at the receiving and delivering counter of the laundry which can do the washing for 4,000 men a week

A familiar camp sight. The customary Monday morning line-up at the laundry

Photos © Int. Film Serv.

General view of the laundry. It consists of four wagons placed together and is operated by a 22-horse-power tractor. The Chinaman-power of the laundry has not been figured out

The Symbol of Each Patriot's Devotion,

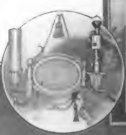
An appropriate setting for the portrait of the soldier

A watch fob which shows the American flag in full colors on a golden shield

Patriotic emblem of classical design to be worn in the buttonhole of the lapel

Breathes there an enlisted man who would not wear such a ring as this?

This bracelet with the President's portrait for young ladies



An incandescent lamp in the National colors is the latest novelty in patriotic decorations for the home

Service emblem transparency for the front window which shows up well

A neat little device that will hold three flags in place. **Use three American flags in it or make a combination of the Nation's flag and those of any two of her allies**

Three Cheers for the Red, White, and Blue

Membership emblem of the Fulton County Corn Growers' Association

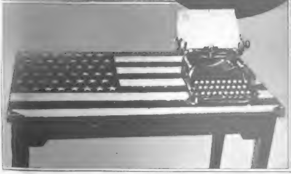
The new Liberty clip for holding the pen or pencil

This writing case makes it possible to write in any position, even squatting as this sailor lad is doing

What the soldier's writing case contains is here shown. It is compact, handy and will please him

An up-to-date dinner favor is in the form of a soldier's hat. Do you like it?

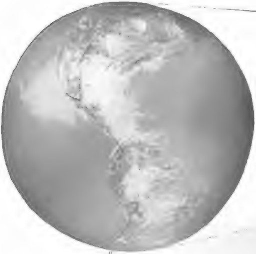
This patriotic badge may appeal to young boys. "Helmet the Kaiser" is the inscription it bears. We are not able to translate it



Typewriter table dressed in the National colors, so that it will not interfere with the typist's speed

Even the baby's dispatch car displays the red, white and blue

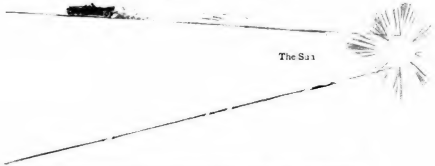
America's Five Million Pleasure Cars Represent



If it were possible to concentrate into one car the aggregate of 120,000,000 horse-power of the 5,000,000 pleasure automobiles in the United States, that car would be able to travel with a speed of 155,000,000 miles an hour, somewhat less than one fourth the velocity of light. Ignoring speed laws it would travel from the earth to the sun in 35 minutes

Each vehicle uses on the average 500 gallons of gasoline a year, a total of 2,500,000,000 gallons. To pump all this gasoline would take one of the modern fireboats eight months. In that time, if the city had been in flames, that same fireboat could have thrown enough water upon the buildings of Manhattan Island to drench every structure

a Total of 120,000,000 Horse-Power



These fire boats are very powerful. At a pressure of 125 pounds their pumps can deliver 5,000 gallons of water a minute. Under favorable conditions the streams of water can be thrown to a height of one hundred and fifty feet or more

From Logs to Legs:—Converting the Limbs That

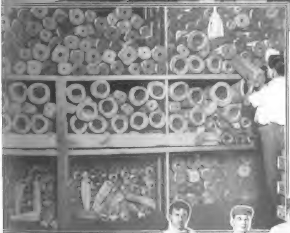
At the right is shown a pile of English willow wood, the principal raw material of the artificial-limb industry founded in Washington D. C., by a Civil War veteran who had lost a leg

Photos © Int. Film Serv.

The illustration above shows the first step—the sawing of the logs into pieces of various shapes before they are put away to season. Only wood thoroughly seasoned is used for limbs

ow on Trees Into Limbs for Crippled Soldiers

View of one of the workrooms, where expert workmen turn out thousands of artificial limbs for the crippled soldiers



Section of the stock room of the factory. It contains enough blocks and partly shaped parts for ten thousand artificial limbs

Many of the employees of the factory are cripples. Here are five who, together, have only three natural legs, and who are now engaged in helping their brothers in misfortune. The factory employs about 250 workmen

Making Game Birds Pay

The propagation of wild game requires careful attention to details. No one who does not feel a deep interest in the birds themselves is qualified to undertake it. Breeders of wild birds are advised to begin on a small scale and learn, by first-hand experience, what those well versed in game farming term the technique. One expert in rearing wild birds advocates for beginners the establishment of a game-raising section as an adjunct to other diversified farming and a gradual development of the project. A few ring-necked pheasants make an excellent nucleus for a game farm for the enthusiastic beginner.

At Amston, Connecticut, on the property of Mr. Charles M. Ams, the National Association of Audubon Societies has built a wild-duck house to solve the problem of wintering. The structure is boarded down into the water to within less than a foot of the bottom of the pond. The pond contains a floating platform on which the ducks may feed, rest and find shelter

Wild ducks and geese on the game farm of John Haywood, Gardner, Massachusetts. The common native Canada goose breeds readily in captivity. The main requisite for raising wild ducks and geese is a small pond

The pictures on these two pages come to us from Mr. Herbert K. Job of the National Association of Audubon Societies. They represent one phase of the interest in rearing wild birds. The possibilities are unlimited. Our domestic poultry was originally a wild species—extremely wild—with

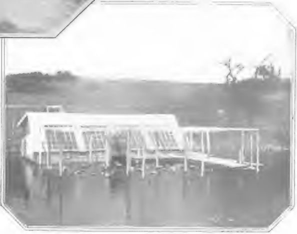
On Your Own Home Farm

They are easy to obtain and, furthermore, pheasant-raising is considered the most profitable branch of game-raising at present. The birds are light eaters, of good size, and they, as well as their eggs, bring excellent prices. Aside from the pecuniary aspects, however, there is a fascination in the raising of game birds which will amply repay the bird-lover for the time and money he may devote to this enterprise. If you are interested in raising game for profit or pleasure, write to the National Audubon Association, 1794 Broadway, New York city, for information on the subject which they are glad to furnish

While pheasant raising is the most lucrative branch of game-breeding, many prefer to rear quails, as the young birds stay with the hen and run with her for shelter to the coop during showers, whereas young pheasants often merely squat on the ground

This is an exterior view of the duck-house at Amston, Connecticut. It solves the problem of caring for the deep-water ducks whose feet, if kept out of water during winter, are apt to freeze

restricted range. Thanks to game farming it is now the most abundant and useful species on earth. What may not be expected of the wild goose, the wild duck, the quail, the pheasant and the wild turkey when they too have been domesticated? Here is a fertile field for lovers of wild life



German Supply Station Is Totally Destroyed

The Railroad Station Is Now a Series of Shell Craters

1. Supply railway trains running on newly-laid tracks.
2. Piles of supplies, chiefly timbers for use in building dugouts.
3. Rolls of barbed wire.
4. Piles of iron stakes used for stringing barbed wire.
5. Steel roofing for dugouts and gun positions.
6. Site of railroad station before it was destroyed by French artillery. Note the big shell craters (about 60 feet across) caused by 420-mm. shells.

7-8-9. Remains of railway tracks near station site.

When a French Airplane Observer Gives the Range

Rails Are Dislodged, Ties Broken, Ammunition Exploded, Supplies Destroyed

10. Broken and dislodged ties of former railway tracks.
11. Other supplies piled up. Perishable goods covered with tent cloth.
12. Battery of four guns, with abris (shelter) for the gunners. Emergency trench shows in front.
13. Dugout of headquarters. The roof can be seen.
14. Ammunition park. Note the German soldiers standing around.
15. German soldiers standing in the road watching the French airplane that snapped their picture and took observations of the destruction.

© Kadel and Herbert

If the blindfolded French soldier succeeds in cutting the string, he gets the package of tobacco suspended

Cut the String, Blindfolded, and Win a Package of Tobacco

THERE are times when the soldiers in their camps or cantonments may give themselves up to rest or pleasure. After all, men are but boys grown up and must have their recreation. Realizing this, the military authorities in France provide as much entertainment as possible for the men off duty, but as a rule the men must rely for their amusement upon their own resources. Games of every kind are played. The illustration shows one of the favorite forms of a blindfolding game played by soldiers in their leisure hours. Strings are stretched from tree to tree and from these strings packages of tobacco are suspended. The player is blindfolded and provided with a pair of scissors. With one hand he seeks to cut the string from which a package of tobacco is suspended. If he succeed the tobacco is his.

Saws Without Teeth to Cut Through Metal

NOT so very long ago the discovery was made in Germany that metals could be sawed easier and quicker with rapidly revolving smooth disks of steel than with toothed circular saws. It was found that the cutting was done by the heat generated by the friction of the edge of the disk against the metal. The metal is melted at the point of contact, while the steel of the disk, being cooled by the air, does not reach the melting point. The disks need no sharpening and do not wear out so quickly as the toothed saws heretofore used for cutting metal. The faster the disk revolves, the greater the amount of heat generated, and the quicker the job.

Introducing the Busy Honey Bee—Ecclesiastical Architect

FOR centuries bees have excited wonder and admiration. Their architectural skill is dwelt on over and over again. But did anyone ever hear of their building a church? It's been done. The accomplished and cultured swarm of superbees that did this belong to Mr. George F. Bowersox, of Portland, Indiana. Unfortunately we cannot give the bees credit for originating the idea. Mr. Bowersox did that. He made a framework of light laths and covered it in so that the bees would consent to use it as a hive. They industriously filled in all the spare space with comb, which is precisely what their owner wanted. The result is that they have allowed themselves to be beguiled into constructing a church, which, as can be seen from our illustration, is a really attractive piece of architecture.

Bees built this little church after their owner's plan

Air Raiders Don't Like These Lights

DURING their recent raids on Paris the German aviators were greatly disconcerted by rockets which the French sent up and which discharged, before dropping, parachutes with brightly burning fuses. These parachutes dropped slowly and their fuses cast a brilliant glare upon the hostile airplanes, making them a good target for the anti-aircraft guns. It is a safe guess that the free fireworks were not enjoyed by the Germans.

The ground pine seems to grow naturally right out of the boulder and the effect is very attractive

Artificial Birds Give a Realistic Appearance to the Flower Bed

BIRDS are sociable creatures. If one finds a pleasant spot and seems to stay around it, his presence will do more than anything else to attract others. For this reason the use of artificial birds in garden plots and as props on which to train growing vines has found favor.

The birds are pivoted on stakes of varying heights so that they may be used in beds of dwarf plants or tall ones. The effect is very pleasing to the eye.

Artificial birds mounted on sticks are ornamental in the garden and attract other birds to the spot

How a Floral Urn Was Made From a Boulder

A LARGE granite boulder hollowed out as a receptable for a potted plant is the ornament which adorns the porch at the home of Paul Brochier, on West Adams Street, Los Angeles.

The rock is practically round, except that it is slightly flattened on the base to give it a firm setting. With an ordinary rock-drill the inside of the stone was hollowed out so that a large flower pot would fit in exactly. A small drainage hole was drilled through to the bottom and a ground pine was planted in the flower pot.

Old Tin Cans Figure in Milady's Costume

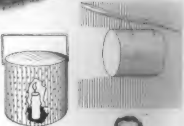
FEW women who are proud of the fact that they wear hosiery, underwear and dresses made of silk, realize that old tin cans contribute from twenty to three hundred per cent. in weight to the glossy silks worn by them. The price of silk has increased enormously and to enable them to sell heavy silks at a price that will yield a reasonable profit and yet be within the means of the average purchasers, the manufacturers resort to the practice of weighting the silk with tin tetrachloride, derived from old tin cans. Five thousand tons of tin were used for that purpose in 1917. Don't throw away the empty tomato cans!

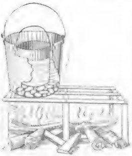
Some Home Camp Comforts For Those

This collapsible canvas house tent is roomy and comfortable, and can be rolled into a small bundle for shipment

A duffle bag with side opening and a waterproof clothing roll made of duck

Candle lanterns made of cans, one for a tree limb and the other for a tent





Boiler improvised of a small and a large pail, the small pail resting on stones

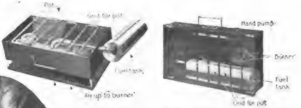
Folding camp chairs, a slat curtain-roll table top and a gas lantern for the camp. A compact and convenient set of furniture

This three-piece camp shovel fits in a one-foot tool box

Who Love Life in the Great Outdoors

Cobble-stone fireplace for burning the campers' garbage and refuse

This life belt of rubber, inflated with air, is kept under pressure in a capsule attached to the waist at all times



A compact automobile folding camp-stove which uses either gasoline or kerosene for fuel

A folding oil-stove with two burners. It occupies little space and is very handy

A home-made carrier for the canteen made of a strap and a snap

This waterproof duck kapok sleeping-pocket has an outside covering to keep the pocket dry when it rains. It is a very useful piece of camp furniture

A canteen which is hung to an overhead branch and tilted by pulley and cord for filling a cup

The Story of a Wireless Hero

How a wireless operator, with great ingenuity and resourcefulness, repaired his apparatus during a terrific gale

By J. Andrew White

I LIKE to think of Wireless Operator A. S. McKenzie as a hero, although he cannot be placed among those who have clung to a swaying table and sent out frantic appeals for aid as a submarine's shells screamed by the radio cabin. McKenzie's battle was against the greater forces of Nature. And not alone that he won, but because he stood a test of overcoming apparently hopeless difficulties by ingenuity and resourcefulness, his experience is worth the telling.

It properly begins at a point 700 miles from shore in a wintry sea. His ship, the *Pennsylvania*, was not large, nor new. She shivered from stem to stern with each plunge into the seething green wastes as the gale increased in fury; with terrifying regularity her after-deck was buried under heavy seas that swirled about the wheel-house and strained to tear it loose. Back in the saloon, off duty, the operator wondered; there had been storms, but never anything like this.

A giant wave bore down on the straining vessel. With a crash and an ominous long-drawn rip, the cover of No. 1 hatch went over the side, the funnel wrenched loose from its stays and the wreckage from a smashed-in bridge, pilot house and wireless cabin swept back with a clutter of doors that had once protected forward staterooms. Below, a muffled rumble conveyed the information that the cargo of liquid asphaltum had broken loose, threatening annihilation of propelling engines upon which safety depended.

The Storm's Work of Havoc Begins

Then, in the tumult, a pungent smell of acid arose and large streams of oil entered the saloon. All hands were puzzled; but the operator knew. The glass plate condenser of his set was mounted on the deck, and the planking was anything but secure. A crippled set to oppose the greed of the furies! A stanch spirit sank before realization of the truth. Slipping and sliding on the oil-soaked floor, buffeted about by the roll of the ship, he fought his way out of the saloon. On hands and knees he struggled to the wireless cabin.

The place was knee-deep in water, the set a wreck. On the floor the transformer coil, two pairs of phones, accumulators, the condenser and all the cells were adrift in a slush of broken glass. A glance assured him that the service switch was up, the starter "off." Salt water, however, had usurped the function of human hands and had made a connection which kept the motor running slowly.

It must be stopped. Scrambling about, gaining a precarious hold and losing it with each wild pitch of the ship threatening to drop him amid the swirl of broken glass and smashing equipment, he worked to a favorable position. A few tugs and off came the wiring.

The Gale Redoubled in Fury

The vessel rolled her top deck under water and pitched like a frightened steed. He fled the place, in search of the captain.

That officer was found wedged in between the stove-in bridge and the pilothouse; he had squeezed into this position to keep from being blown overboard. McKenzie reported conditions.

"Leave everything and go below!" bellowed the captain. "We can do nothing now but try to save the ship."

And below he stayed through a night of terror. There was no sleep for anyone.

With the first flush of dawn the wind died down. The day broke clear, but mountainous seas still tossed the vessel about like a cork. No immediate need for an SOS appeared, but there were important orders to be received from the owners, the captain remarked as he disconsolately viewed the wreckage in the wireless room. Every effort must be made to patch things up enough to get a message through.

"I Listened and Caught the U. S. S. Proteus"

Standing knee-deep in water—transformer coils, phones, accumulators, and cells adrift in a slush of broken glass—salt water having established a connection that kept the motor running slowly, and which must be stopped, a nearly exhausted operator, after hours of back-breaking efforts and dogged persistence, won the day—he got his message across

At nine in the morning the operator began to work, assisted by the ship's carpenter. Time passed, but practically no progress had been made on the slippery floor; then a thoughtful mate sent up a bucket filled with sand. An hour had elapsed before the transformer was back in its case and made fast. The auxiliary and accumulators were removed entirely and the condenser set upright. Spare plates which had been kept on the floor had somehow remained whole, but the acid had attacked the tinfoil and it was peeling off most of them. The container was cracked.

Asbestos Paste to the Rescue

An appeal to the engineers brought some asbestos paste to the cabin, and a so-called repair was effected. The result of four hours' intensive work was a condenser haphazard in appearance but boasting twenty-four plates.

With an intermission here consisting of space for a long-drawn breath, McKenzie turned to the task of drying out the rest of the equipment. The rheostats had to be taken down, dried and oiled with insulative oil. The starter and the transformer required the same treatment. Two solid hours were spent on the motor; first the brushes came off and the inside was oiled as well as possible; there was no time to take out the armature.

Resourcefulness Wins an Inning

It was eight o'clock then. Eleven hours of exhausting work lay behind the operator, but the race against time did not allow for a stop for dinner. He tried out the set. The first thing to go was the generator rheostat. Patiently he repaired it. It blew again. With twenty feet of iron wire wound on a pencil he created a resistance. This, after a series of patient experiments, performed its function, although the motor ran unsteadily and sparked furiously. Another precious hour had been lost.

Once again the set was started, the key depressed and a radio land station call flew off across the sea. "A great moment," McKenzie describes it. "I waited. No answer. When I tried again the starter burned out in two places.

"Once more the asbestos paste proved invaluable; but the release magnet now refused to hold. With wire I hooked it up. The motor started then; but this time the field rheostat went on strike."

More Repairs Under Difficulties

Painstaking repairs were made, only to learn that although the apparatus operated, the generator rings were arcing across the dividing rings while the brush holders were leaking into the frame.

"These defects were remedied," says the operator, telling of his experience, "and I tried again. It was now midnight. I called CQ for a long time but received no answer. . . . I had forgotten that the phones had been in acid and water all the day before.

"Although I dried out the headgear in the steam oven it was as wet as ever again in ten minutes. I tried cleaning the phones, while warm, with gasoline. Still I could hear nothing.

"The aerial was intact. I tried the tuner with the battery and found it dead. At two in the morning I succeeded in drying it out.

At Last a Hopeful Sign

"I listened and caught the U.S.S. *Proteus*. My spirits rose. I called him —and away went the condenser, shot to pieces!

"Two hours later it was rigged up again, but the motor brushes were shorting through the frame.

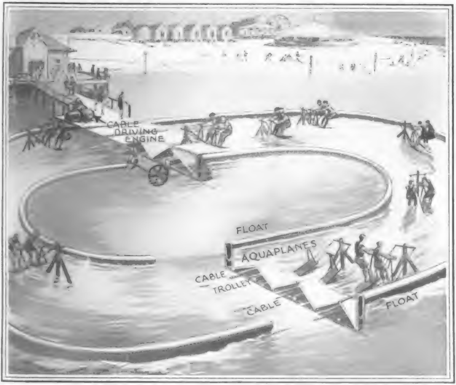
"I quit, and turned in for a nap."

At six in the morning, after a scant hour and a half's sleep, McKenzie turned to the job again. The sea still lashed viciously at the vessel's side. Practically all his work had gone for nothing. Every seam in the wireless cabin was open, the roof badly sprung and his set as wet as ever. But at noon, after six hours of back-breaking effort, he considered everything in readiness and again tried to start up. Nothing happened. All the current went to ground through the soaked insulation.

With dogged persistence he turned once more to the task. Hours slipped by, precious ones. It was eight o'clock in the evening when a nearly exhausted operator concluded his long labor with motor and wiring. But it was done; a loyal sense of duty was rewarded—this time he got his message across!

Aquaplane Racing Full of Genuine Thrills

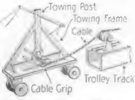
Novel racecourse provides hilarious fun with many thrills but no danger



Each channel is supported by tubular floats. The tracks, two or more in number, are elliptical. The shallow water eliminates danger but is wet enough for thrilling spills

DID you ever see an aquaplane race? If you like fun, do not fail to visit the nearest aquaplane racetrack. Of course, you have seen aquaplanes in tow of fast launches, crazily lunging in the turbulent wake of the propeller, while some daring bather made frantic efforts to maintain his balance.

The aquaplane racetrack shown in our illustration is the invention of Hubert A. Myers, of Toledo, Ohio. It may be divided into two, three, or more parallel channels which form the tracks for the aquaplanes. The moving power is a cable kept in motion by a gasoline or other kind of engine. The aquaplanes are attached to upright posts of a framework, the submerged part of which runs on small trolley wheels, within a grooved trolley track, gripping the cable by means of a "gripper."



Showing how the "gripper" engages the running cable

The race is full of thrills and spills, duckings and jeers, laughter and cheers.

The problem of dividing this strawberry shortcake, too big for a knife, was solved by sawing it

A Giant Strawberry Shortcake. It Had to be Cut with a Cross-Cut Saw

EVERY year the little town of Burton, situated on Vashon Island, a few miles from the city of Tacoma, holds a good old-fashioned strawberry festival to which the public is cordially invited. The Island Commercial Club, a "live-wire" in the community, conducts the festivities. Heretofore plain strawberries, sugar and cream have been the order of the day, but the committee that had charge of the affair this year took it into their heads to do something different and original.

Accordingly they waited upon two members of the Burton Woman's Club, far famed for their culinary accomplishments, and told them to put on their thinking caps. The ladies rose to the occasion and the result was the making of a strawberry shortcake of exquisite taste and generous proportions.

No knife equal to the situation could be found, but H. G. Parkes, president of the Commercial Club, suggested the use of a cross-cut saw. Everybody echoed "Why not?"

Remove the handle of your grip and it will be safe from thieves

No Very Great Danger in Making Explosives

IN a paper read before a medical association in the East, Dr. W. G. Hudson, medical director of E. I. duPont de Nemours & Co., manufacturers of explosives, recently made some interesting statements concerning the risks connected with the manufacture of powerful explosives. He asserted that the dangers of that industry were greatly exaggerated. As a matter of fact, railroading shows much higher injury and death rates than the manufacture of explosives. Of the accidents which occur in explosive factories only a small percentage are actually caused by explosives. Four-fifths of the accidents are due to carelessness or negligence of employees who disregard the precautions necessary wherever men are working with tools and machinery. By increasing the share of work done by machinery and reducing the number of workers in proportion to the increased use of mechanical appliances, the manufacturers of explosives are striving to diminish the hazards connected with their business.

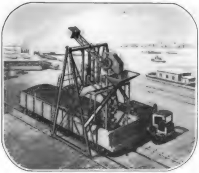
Use This Detachable Handle to Protect Your Grip

IN order to make it at least very awkward for a thief to steal a bag, Mr. A. C. Aagebery, of Indiana, has invented a detachable handle. This can be fitted to both new and old bags and valises. It is merely a pair of sockets into which the removable handle-piece fits and from which it is removable by pressing a button.

The handles being non-interchangeable, theft by fitting another handle is not possible. The thief would have to carry the bag under his arm.

Unloading Freight Cars by Machinery

No worry then about shortage of labor



Accelerating the unloading of railway cars by the use of endless-chain buckets

SOME of the congestion of railroad traffic since the outbreak of the war has been partly due to the detention of loaded cars in railroad yards or on sidings. In many cases companies pleaded that the scarcity of laborers made it impossible for them to unload their cars promptly. Hence, mechanical unloading of freight and coal cars has become of vital importance.

Recently a Chicago inventor put on the market a mechanical unloading device, which, he claims, will not only mean a large saving of labor but also reduce the cost of unloading to one-third of what must now be paid to shovelers. The device consists of an endless-chain bucket elevator carried by projecting arms which are counterbalanced by a concrete block at the opposite end and mounted on a pivoted frame supported on a traveling bridge or crane which straddles the car and can be moved from car to car as the work proceeds.

One man is sufficient to operate this machine, which, according to the material, will unload from thirty to forty tons an hour. At that rate one operator with this machine can unload five cars in one day. To do the same amount of work by the old method would require about ten or twelve men.

The traveling belt (at left) receives its burden from buckets unceasingly and deposits it where wanted

The bucket-chain elevates the material to a horizontal belt which deposits the material removed from the car wherever it is wanted. Both conveyors are operated by small electric motors controlled from the operator's cab.

The entrance of the United States into the war has acted as a stimulus to inventive genius, and since the war necessarily removes from ordinary channels of labor a large percentage of men, any device that holds out promise of usefulness in substituting mechanical labor for that of man is worthy of more than passing consideration. If this inventor's claims are substantiated, one of the most serious causes of delay in freight-handling will be eliminated.

The combination croquet-pool game. Except for the pockets on the corners and sides no special apparatus is used when the game is played outdoors. For indoor play lighter balls are desirable

Combining Two Favorite Sports—Croquet and Pool

CROQUET enthusiasts and devotees of the pool table may enjoy the new game, shown in the accompanying illustration. It may be played either outdoors or indoors.

Pockets are fastened in place on the ground exactly as on a pool table, one at each corner and on each of the longer sides. By numbering the balls combinations such as lend fascination and excitement to pool may be obtained. Except for the pockets no special apparatus is necessary. The regulation croquet balls and mallets answer the purpose; but for indoor use lighter balls may be found more desirable and less noisy.

Water-filled Roller Combines Scraper and Handle-Lock

A MANUFACTURER of Berea, Ohio, has recently placed on the market a combination handle-lock and roller-scraper for use with lawn rollers weighted with water. This device holds the handle upright when it is not used, thus making it unnecessary to counterweight the handle. The scraper may be lowered for cleaning the roller surface. The weight may be regulated [illegible]lume of water.

When roller is not in use the lock holds up handle

Over Fifty Different Woods Are Sold as Mahogany

THE name "mahogany" is applied commercially to more than fifty different woods. Perhaps half the lumber now sold under that name is not true mahogany, for the demand greatly exceeds the supply.

The tree is only native to the limited area between southern Florida and northern South America. Nowhere else does it really flourish. But the public will have mahogany. Women want it for furniture, business men prefer it for office fixtures, and teak and mahogany are rivals in the affections of ship-builders. Therefore substitutes flourish.

It is not surprising that the real wood is so expensive when it is learned that it takes from one hundred to one hundred and fifty years for a mahogany tree to reach merchantable size.

Most of the substitutes bear little more than a general resemblance to the genuine wood, but skillful finishing makes them very much alike. Experts can usually distinguish between them by the aid of an ordinary pocket lens. The efforts of the superficial, however, to judge the wood by its appearance, weight, grain, and color often lead them astray.

Making Money Out of Rabbits

How a young woman taught herself fur-raising and tanning and engaged in a business that anyone can learn

After being tanned the skins are softened by scraping and rubbing

A YOUNG woman in Los Angeles, Mrs. Carl Sherman, has taught herself fur-raising and tanning and maintains a "rabbitry" of three or four hundred choice specimens. She is the founder and instructor of the "Southern California Coney Fur Club," and has a large established trade both in skins and garments of fur.

Instructions in rabbit-raising and tanning were obtained from the Government. To learn garment-making she sent to Chicago for the cheapest set of furs of fashionable cut that could be had. These she carefully ripped up, studying the seaming and finish, and afterwards using the pieces for patterns. Now she makes fur sets—muff and cape—that sell for forty or more dollars.

In her own back-yard, on a fifty-foot lot, are pens of up-to-date construction full of aristocrats in the coney-world—Himalayas, English Snow Shoes, Imperial Blues, Flemish Blacks, French Silver, little Japanese and other varieties. And in her cottage are chests full of preserved skins that sell for eight dollars each unmade, while her transactions in made skins amount to several hundred dollars a month.

Yet a child could learn the trade, she declares. The formula is simply five gallons of water, four pounds of common salt, and two ounces of sulphuric acid, made into a solution, in which the skins are soaked from six to twenty days according to their weight; they are then dried in the shade, pulled and stretched by hand, and rubbed over the edge of a hardwood board until pliable. Finally they are immersed in gasoline, rubbed over while wet with cornstarch or fuller's earth, dried in the sun, and brushed.

Only aristocrats of the rabbit world occupy apartments in Mrs. Carl Sherman's strictly modern hutch

Having mastered the business in its details, Mrs. Sherman last October formed a club of her neighbors, which in December had thirty-two members, all raising their own rabbits, tanning their own skins and making fashionable fur pieces for the trade.

The club prepares an exhibit of fur garments for the annual show of the California Rabbit Association. This exhibit includes a wide variety of fur pieces, such as hats, muffs, capes, scarfs, slippers and bags—all of fashionable cut and beautiful shades and markings. The club never lacks a market for its wares; as a matter of fact, the members find the demand exceeding the supply.

Six motor-cycles on each side in this tug-of-war pulled until they were exhausted

Two Teams of Six Motor-Cycles Have a Tug-of-War

"ARE you ready? Go!"

Then follows a series of explosions. "Gr-r-r! Bang! Bang! Bang! Whoosh! Pop! Pop! Pop!"

This, coupled with clouds of sand flying, and shouts and laughs from the spectators, gives a slight idea of what recently took place on a California beach.

Following a friendly argument concerning the pulling power of different makes of machines by members of the Los Angeles Motor Cycle Club, a tug-of-war for motorcycles was arranged. The competing machines were arranged in teams of six, and hitched to a one-hundred-and-fifty-foot manila cable. The engines were started up, and, at a given signal, all the clutches were let in together. For ten minutes the game little machines pulled each other back and forth along the beach. At the end of that time they had all dug themselves in until they could run no longer. The winning team won by just eight inches!

Bathtubs for the Eyes. They Have Running Water, Too

FRIEDRICH MAIER, of Elizabeth, N. J., suffering from some eye trouble, consulted an eye specialist who recommended, as part of the treatment, frequent bathing of the eyes in cold water. Mr. Maier found these baths beneficial, but did not like the manner of taking them. After having given the matter considerable thought, he made a pair of miniature bathtubs for the eyes, fitted them to the head like goggles, and fastened them securely in place by a strap around the head. He fitted each of the little bathtubs with an inlet at the top and an outlet at the bottom. Connecting the inlets by means of rubber tubes with a water reservoir or the faucet and turning on the water a stream of water flowed through the two bathtubs, washing the eyes and eventually draining through rubber tubes connected with the outlets into a basin or the sink.

Bathing both eyes at the same time

The inventor was thoroughly satisfied with the efficiency of this apparatus and so was the eye doctor for whom he made a copy of the device and who used it with excellent success in his clinic.

The device is of great value in all cases where a continued washing of one eye or both eyes is necessary. As the cups are provided with glass fronts like goggles, the doctor can observe the effect of the washing upon the eye of the patient. The device can be used for but one eye or both, as desired, and the patient may be standing, sitting, or lying down.

The illustration explains better than words can do the method of using this apparatus.

Making Soap from Table Refuse

TO conserve the fats contained in the table refuse and dishwater of the soldiers' mess, the British military authorities installed grease traps. The fat collected in these traps averages more than one ounce for each man daily. The trap consists of a tin-lined wooden box, divided into two compartments by a partition which does not reach the bottom by about four inches. The dishwater and the table refuse are poured through a strainer into the vat. As the water cools, the fat forms a crust on top and is skimmed off.

Columbia University's fifteen-ton sundial. You can't set this timepiece ahead an hour to save daylight

This Press Can Make Two Thousand Bricks of Fuel a Day

THE scarcity of coal in all belligerent countries has imposed upon all nations the necessity of exercising great economy in the use of fuels. Long before the war economic reasons made it desirable to find some method of utilizing coal dust, sawdust, peat and lignites for heating purposes. Briquettes were invented and to some extent used. The war revived the interest in briquettes, and several new presses for making them were invented.

The device shown in the picture is by a French maker who claims that one of these machines, operated by three men, can turn out from fifteen hundred to two thousand briquettes daily, each weighing about six and a half pounds. Briquettes may be made of coal dust, sawdust, shells of nuts or cacao beans, leaves, peat, etc.

A fuel-briquette machine which can turn out about two thousand briquettes a day

Giant Granite Ball Tells Time with Great Accuracy

A HUGE shining ball of green granite, weighing more than fifteen tons, is placed at the edge of the campus of Columbia University, New York city, for use as a sundial. It is set on a solid stone base on the upper surface of which are mounted two curved brass plates. The edges of the oval shadow cast by the ball fall along the two brass plates and a comparison will give the correct time. Professor Jacoby, of the astronomy department, has estimated that the degree of inaccuracy of the sundial is never more than a fraction of a minute.

The monumental ball was a gift of the class of 1885 to commemorate the twenty-fifth anniversary of their graduation. Professor Jacoby, realizing the possibilities of rendering the ball useful as well as ornamental, had the two calibrated plates attached.

When this canvas-covered frame is hauled across the field, it bewilders the grasshoppers so they hop into it

Catching Grasshoppers by the Bushel

IN a Western State where grasshoppers threatened entirely to destroy farm crops, an inventive farmer made the grasshopper-catcher shown in accompanying illustration. The device consists of a framework over which is stretched canvas. On lower front section the teeth of a mowing machine are mounted to form a "catcher." As the contrivance moves over the field the insects jump and are caught by the catcher. A horse pulls the grasshopper catcher along.

How a Woman Makes Money by Putting Nature Under Glass

A YOUNG woman, dressed for "hiking" and walking with a brisk and elastic step, is approaching from the direction of the town. Her eyes, clear and keen, searchingly wander from one side of the road to the other. At a sandy strip she leaves the road and begins to gather some of the graceful, feathery whisps of black grass growing there. She chooses critically and uses great care in placing the grass in the tin case which she carries by a strap over her shoulder.

A short distance beyond that sand lot, a marshy meadow attracts her attention. Boldly she wades into the swamp and seems pleased when she finds some of that dainty and delicate grass which is known as "fairy grass." On and on she wanders, stopping here and there to gather some purple, lavender or almost black grass, some fragrant Sea-Lavender, some early golden rod. Along the railroad tracks she gathers clumps of Poligonella, our cousin to Scotch heather, and every now and then she makes use of the net which she carries to capture some tiny butterfly with gorgeously-colored wings.

Who is this woman? Why does she collect these specimens, many of which seem so unattractive and commonplace? If you have taken your stroll in the vicinity of Lexington, Mass., you will recognize her as Miss Rose Whitney Smith, who has turned the pleasures of a naturalist's work to practical use and has built up a flourishing industry in which grasses, flowers, butterflies, etc., are skilfully employed for decorating trays, mirrors, screens, etc. The specimens are carefully prepared and arranged artistically upon a background of silk, protected on the one side by plate glass, on the other by a substantial wooden or metal back.

Ornamental Concrete Pools Take Place of Old Swimming Hole

THE delights of outdoor swimming in summer are made possible in cities by the building of concrete swimming pools. The expense is so small that even residences can afford them. When set among forest trees, a concrete swimming pool is an attraction. Water may be secured from natural springs or streams.

The concrete pools are easily waterproofed by proper construction. The main point to avoid leakage is to use good material so proportioned as to get a dense mixture; this, when well tamped, makes walls and floor water-tight or practically so. Concrete pools are proof against corrosion, and if well built are practically permanent. Therefore the cost of excavating and construction may be considered practically the only expense. Ornamentation consisting of balustrade and columns will, of course, increase the expense.

It is in the inland city where the youngsters never get a chance to splash about except in the bathtub or some abandoned quarry that the concrete swimming pool is most appreciated.

The best type of pool for such places is exemplified at Austin, Texas. This pool is 200 feet long and 100 feet wide. For the first twenty-five feet it has a depth of twelve to eighteen inches, and accommodates scores of small children. In the next 150 feet the depth ranges from three and one-half to four and one-half feet, while the depth of the last 25 feet, for diving, is eight feet. The pool is constantly filled with filtered water, supplied at the rate of five hundred gallons a minute.

Concrete swimming pools bring delight to city-confined youngsters of all ages. The cost of construction is the only expense

Making Use of Tomato Seeds and Skins

TOMATOES are used in enormous quantities in the United States for food purposes and as a condiment, and the industry of canning tomatoes and that of making catsups or soups of them has developed to considerable importance. In the making of soups and catsups only the pulp of the tomatoes is used and heretofore the skins and seeds were discarded as useless.

Recently economic chemistry has called attention to the possibility of utilizing both the skins and the seeds of the tomatoes. From the seeds 17.3 per cent of oil can be obtained, which has an agreeable smell and taste and a caloric value equal to that of olive oil. When treated with driers it acquires good drying properties, and is also useful in soap making. The seeds from which the oil has been removed and the skins of the tomatoes can be pressed into cakes which have considerable value for feeding cattle. Or the mixed mass may be spread for fertilizing purposes. Its manurial value was found to compare favorably with barnyard manure in potash, phosphoric acid and nitrogen.

Considerable work has already been done in Italy and other foreign countries toward utilizing tomato refuse and in the Italian province of Parma about 12,000 tons of skins and seeds are worked up into oil and fertilizer every year. In the United States, however, this matter has not yet received proper attention. Stress of necessity, however, gradually calls attention to the value of many things formerly regarded as useless.

Housekeeping Made Easy

A steam cooker set over the ordinary teakettle for canning fruit

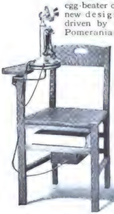
Comb cleaner made up of threads in the form of a razor stropper. It may be washed when necessary

An attractive holder for the whisk broom. The broom forms a Fiji skirt for the girl

A double egg-beater of new design driven by a Pomeranian

An ash barrel truck that can be pushed up and down the steps

An electrically operated ironing roll for the home laundry. It is heated by gas



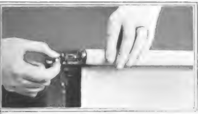
A convenient chair for telephoning at the home or office

A double boiler, with removable bottom, for cooking rice and other cereals

A kettle cleaner which has brush and scraper on opposite sides

Housekeeping Made Easy

A convenient hanger for the telephone book which snaps into the hole in the book



Adjustable brackets to make curtain poles fit any window

An electric washing machine which works on the vacuum principle

A cake tin with a detachable rim for cakes of all sizes

A smoking stand with ash tray of original design

Illuminated push buttons on an electric light switch—coated with luminous paint

A new design of a pot-cleaner which is shaped like a hat-stretcher

Grill or broiler for cooking steaks over a single-flame gas burner

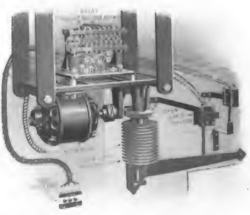
This little attachment tilts the chair as desired

Garage Doors that Save Space and Time

Some fold up like a screen; some swing around a corner; and some can be operated merely by pushing a button

EVENTUALLY, the automobile owner who builds his own garage is confronted with the problem of selecting a door which will require as little inside space as possible and yet give the least trouble in opening and closing. The old-fashioned swinging doors, like those in our dwellings, are not space-saving enough to suit modern conditions. Whether they open inwardly or outwardly, they require altogether too much space for their operation.

Numerous ways have been devised to overcome this difficulty. One of the simplest plans is to make the door of several narrow parts hinged together in such a manner that they fold up like a screen. A door of this type, for a two-car garage, is shown in one of the illustrations accompanying this article. In that case the door is divided into five hinged parts. The illustration clearly shows the manner of operating it.



This electrical device will open or close the garage door. The clerk in the office can do it by pressing a button

There are many kinds of sliding doors. One of the pictures illustrates one in two parts working like the sliding doors of show cases. Another kind shown is the sliding door which is swung around the corner. Both these types require but little space for opening and closing, but they must be mounted on roller-bearing hangers if they are to be operated without too great exertion by a woman or child. Types of such hangers are shown in the accompanying pictures.

This shows one of the ordi[illegible] sliding doors with two p[illegible]

The doors of large public garages have to be opened very frequently and at all hours of the day or night. This necessitates constant attendance upon them. The device shown in one of the illustrations enables the clerk or stenographer in the garage office to open or close the heavy garage doors without leaving her desk, simply by pressing a button. The device consists of a small electric motor geared to a cable-drum. The current is controlled through a set of push buttons and a relay. When the starting button is pressed, the current is sent through the motor which operates the drum and, by winding up the cable, pulls open the door until a metal contact on the door itself comes into play against a switch-bar, supported by the small overhead frame that carries the motor. This shuts off the current and leaves the door open. To close it, a second button is pushed and the door is closed in the reversed order, with a similar switch to shut off the current when the door is closed.

This garage has folding doors that slide in grooves and require little "elbow room"

It is self-evident that the ease with which large doors may be operated depends primarily upon the nicety with which all parts are fitted and upon the quality of the materials used. An ounce of prevention being worth a pound of cure, it would be poor economy to resort to inferior labor or material to save a few dollars on the initial expense, only to have to pay a repairman a more or less heavy bill after a short time.

Different styles of rollers that are used for the sliding doors of garages

This sliding garage door swings around the corner and requires very little inside space

An Automobile that Got Its Power from the Street Mains

AN automobile provided with a compressing plant by means of which gas could be taken from mains in the streets and compressed into the cylinders, in which it was stored as fuel for the machine, is the work of W. H. Dunkley of Birmingham, Ala. The plan included the employment of charging stations erected in the streets. Payment for the gas could have been made by means of slot meters and gas pass keys.

The Dunkley automobile was made in the early days of the use of coal-gas as a fuel for machines. It had a twin-cylinder opposed horizontal engine and the portable gas compressor was made up of two water-cooled cylinders at right angles to and above the power cylinders. The cylinders in which the gas was stored were of the standard type used for oxygen.

An idea for fitting hollow disk wheels as auxiliary reservoirs for gas was also evolved by Mr. Dunkley.

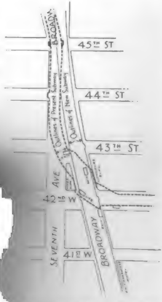
Building a Subway Under a Subway

Little do New Yorkers know that they are traveling on a suspended subway even though it is underground

By Howard B. Gates, C. E.

MANY residents of New York city no doubt remember the time when the possibilities of subways as a means of rapid transit were as little realized as the practical application of the airplane, in its present development, is now considered, to our everyday life. But within the last fifteen years a most wonderful system of subways, comprising more than two hundred miles of underground railroad, has been built in New York under enormous difficulties at an expenditure of more than $400,000,000.

Statistics show that nearly 2,000,000 persons are carried by this system every day and that more than seventy-five per cent. of this number seek its accommodation between the hours of six and nine o'clock in the morning and between four and seven o'clock in the evening. One of our largest railroad systems, with some 26,000 miles of track and traversing thirteen states, carries but one-third of this number. During "rush" hours, even standing room is at a premium, although ten-car trains, each carrying 2,000 persons, are operated under a one-and-one-half-minute headway, controlled by elaborate electrical [illegible] and [illegible]



[illegible]gram showing relative locations [illegible] the old and the new subways

such a structure beneath an existing and operating subway, without entering or disturbing the structure above. Although the average weight of the subway may not be more than a ton to the square foot, there are points, at the columns for instance, where concentrated loads of two hundred or three hundred tons, together with adjacent heavy and rapidly moving trains, make any disturbance to the equilibrium or stability of the temporary or permanent supports a matter of considerable responsibility and concern.

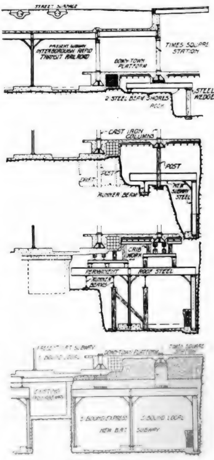
Such a piece of work is now in progress beneath the present Times Square station at 42nd Street and Broadway, passing diagonally beneath that station for about 250 feet of its length. Any interruption to operation at this point would congest the entire system, and yet, under a considerable portion of that structure, the original foundations have been supplanted by a complicated system of steel beams and timber supports. Traffic is maintained and the 300,000 persons who use the subway daily at that point do not even know what is going on beneath them. The new structure also has four tracks, two local and two express tracks, and will be operated by the Brooklyn Rapid Transit Company. Connecting passageways will lead from the transit company's present, recently completed station on Broadway between 40th and 42nd Streets to the Interborough station above.

New York's Two-Storied Subway

While train after train, loaded with passengers, ran into Times Square station of the New York subway and out again, and while millions of persons, on foot and in vehicles of every character passed over **the spot on the surface, a new, four-track subway,** to be operated by the Brooklyn Rapid Transit Co., was constructed, crossing 42nd Street under the tracks of the old subway. Can you realize the tremendous difficulty of the engineering task involved **in the gigantic undertaking? Read how it was done.**

Eliminating all but the most vital technical details, the problem becomes one of blasting the rock from beneath the present station over small areas, which are self-supporting and which are subsequently shored by steel beams and timber supports before any further progress is attempted. To allow for the blasting and removal of the rock without endangering, to any serious extent, these temporary supports, the arrangement of the shoring must be changed from time to time until enough of the new structure can be finished safely to sustain the structure above. The support is arranged temporarily until the new work is completed, whereupon the permanent footings of masonry are placed.

By referring to the illustrations, it will be seen that, while a meshwork of light steel beams resting on posts or other temporary work serves to support the platform and lighter portions of the station, the shoring of the platform columns, each of which is computed to carry a load of about two hundred tons, has to be advanced in slow and expensive stages. The cast-iron bases of the columns are first carefully exposed and enough of the foundation concrete and rock removed to allow placing large steel beams beneath sides of base.



How It Was Done

The top diagram shows the first step. Large steel beams were placed under the partly exposed columns of the old subway as a shoring and wedges hammered in until the weight was lifted. Then these were replaced with a single heavy timber post, directly under the original column. As the new steel-work progresses and is filled up with concrete all the shoring is taken away until at length the structure stands complete, one subway on another

Wherever the headroom or working space is sufficient, these beams are supported on well-placed timber columns beneath which steel wedges are driven, until there is a visible separation between the cast-iron base and its original foundation, indicating that the full load of the column above has been transferred to these temporary supports. The rock foundation is then removed to about a foot below the roof of the new subway, whereupon a single square timber post, accurately centered under the column and wedged to take the full load, replaces the shoring beams and releases them for use at other points.

Working at the new subway roof level, small rectangular cuts or "drifts" are excavated and timber posts placed for the support of the structures above. Where the character of the rock permits, the excavation is next made to a depth sufficient to assemble a portion of the new structure. Where the full depth cannot be excavated without endangering the supports, long "runner" beams, upon which several sets of roof girders are placed, are set in concrete bearings upon the rock. Another "pick-up" of the platform column is now made by means of a crib-work of steel beams and blocking, built up from the permanent roof steel.

The method of procedure in excavating, as described up to this point, has been in the direction of the width of the new structure, but with the "runner" beams in place, the work progresses in the direction of these beams. As fast as the rock is removed beneath the "runners," posts are placed to carry the free end and, with the other end supported on the original rock, the remaining foundation can be removed with little danger to the subway overhead.

The new structure is next completed, whereupon all temporary shoring and supports are removed and the subway above is restored upon the roof of this new work, filling all voids between the two structures with masonry. It goes without saying that the work is carried on from the adjacent unfinished portion.

The base is rigidly anchored to the ground; yet it "gives" slightly when the runner hits it

This Tobacco Pipe Is Built Like a Cornet, But Isn't Musical

A TOBACCO pipe of unusual design has been invented by Warren Murray Baechtel, of Hagerstown, Md. Every pipe-smoker knows that the longer the stem of his pipe the cooler will be the smoke. Pipes with stems a few feet long have been in use in different countries for many years, but their awkward length precluded their use outside of the house. The inventor of the pipe shown in the illustration circumvented the difficulty by coiling the stem of the pipe like the tube of a cornet or signal horn. The coils are connected at their lower end to form a dripping-chamber for receiving the saliva which accumulates in the stem. Each coil has an independent opening into the dripping-chamber and a screw cap at the bottom gives access to it for the removal of the accumulated saliva. The smoke, in passing through the coils of the stem, is drained several times of saliva and nicotine.


The long, coiled stem, without being awkward, insures a nice cool smoke

A Baseball Base Which Moves When It Is Hit

AN improved baseball base, which is anchored to the ground so that it is secure and yet is able to yield, has been invented by Sydnor M. Falconer, of Washington, D. C. Bases, as they are now fastened to the ground, are often torn from their moorings, or they are so immovable that they injure the player when he strikes them at great force. The base described is provided with a coiled spring, which enables it to move slightly from its anchored position and thus prevent the player from getting injured. When released, the base returns instantly to its former position.

When a base-runner comes sliding, hands first or feet first, with considerable speed against an immovable base, he is very apt to sustain a sprain or other serious injury. This device should therefore appeal to those players whose ambition frequently makes them risk their limbs in the base stealing of bases. A similar device, which would make the football-player's anatomy bend instead of break on contact, is desirable.

The cane, with sewing-bag attached, is stuck into ground near chair, leaving you unencumbered

Red Cross Knitters and Sewers, Please Learn How to Use a Cane

IF you enjoy sewing out-of-doors, but object to a lap-full of the necessary materials, here is a little device which will make sewing in the garden an unalloyed pleasure. And best of all, you may not have to buy a single article in order to have this attractive combination sewing-bag and table.

Take a cane and attach to it a cretonne bag about twelve inches long, and divided into two parts. Stick the cane into the ground, and you can sew as comfortably as if you were indoors.

Soap and Fertilizer from Dead Locusts

LOCUSTS are plentiful in Uruguay and the farmers of that republic are compelled to keep up a constant war against them. Millions of these destructive insects are killed every year. Recently it was learned that soap, fertilizer and lubricating oil may be obtained from the dead locusts, and in the future they will be utilized for that purpose.

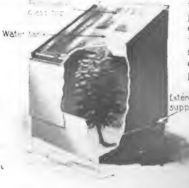
A Soap Bubble Can Be Made to Last for Months

THE air of an ordinary room is filled with tiny particles of matter which fall on the airy soap bubble, alter the surface tension, and—poof—it is gone. The effect of these minute particles on the stability of bubbles was first brought to light by Sir James Dewar. He experimented in clarified air until he was able to produce bubbles which lasted for months. He has even produced a soap film, which was a year old recently and which seems to remain just as it was made.

So tell the children that the secret of successful soap bubbling is to have a perfectly pure soap-solution and to blow the bubbles in and with air that is also perfectly pure.

Individual Protective Housing for Delicate Plants

FOR the protection of transplanted hothouse plants, Mr. John C. Mueller of St. Louis has invented a device which may be described as an individual protective housing with hothouse and irrigation features. The box-like device with a slanting top is placed over the plant which needs protection and is secured by pressing the lower edges of the structure into the ground. A removable top with strips of glass and ventilated by holes with raised edges, calculated to keep the rain-water from flooding the plant, is provided. If desired, a water tank may be placed in the upper part of the housing, from which water may be slowly supplied continuously to the growing plant. In case the growth of the plant should make it needful, a second or even a third story may be placed upon the original structure.



This device protects the delicate plant from excessive cold, heat, rain, and wind

Who Won the Motor Contest

An interesting collection of labor-saving devices brought forth in the Popular Science Monthly's prize automobile contest

THE POPULAR SCIENCE MONTHLY'S motor contest has been a huge success.

The first prize of $100 goes to Mr. C. A. Butterworth of Newton Center, Massachusetts; the second prize of $50 goes to Mr. P. C. Haas, of Ann Arbor, Michigan. Both prizes were won by young men in whom invention seems to be a cradle-gift, for neither makes his living as an engineer.

On the left, Mr. P. C. Haas, winner of the second prize of fifty dollars. On the right, Mr. C. A. Butterworth, winner of the first prize of one hundred dollars

It is significant that both prize-winners made use of the electric current to carry out their labor-saving ideas. Electricity is playing an increasingly important part in reducing the muscular labor required to drive the car. We have only to cite the electric starter and to contrast it with the old laborious hand-crankers to drive home the point; or to mention electric lights, turned on and off by a switch from the driver's seat, thus eliminating the flickering oil lamp or the gas lamp with its leaking pipe; or the electric water temperature controller which insures efficient engine operation as against no controller at all; or the electrically operated gear shifter as against the hand shifter; or the score of electric comfort-giving accessories.

Mr. Butterworth, the first-prize winner, is a young man who has had no academic mechanical training and who has not even had a lesson in mechanical drawing. He has worked out an electrically controlled hydraulic gearshifter with an automatic clutch throw-out. It eliminates the physical exertion expended in the present type of car whenever it is necessary to shift gears. In addition, it does away with the physical labor required of the foot to push down on the clutch pedal and to disconnect the engine from the driving mechanism whenever the gears are to be shifted.

It was our intention to publish complete drawings of Mr. Butterworth's invention in the present issue of the POPULAR SCIENCE MONTHLY. We find, however, that the time at our disposal is too limited for an adequate presentation of the subject. Hence we must ask our readers to wait for the July issue, in which full justice will be done to Mr. Butterworth's ideas.

The winner of the second prize of fifty dollars, Mr. P. C. Haas, has invented an electrically operated steering gear controlled by means of a small switch mounted on the steering wheel, retained for looks and for cases of possible emergency. The task of guiding a car saps both the physical and nervous energy of even the most hardened driver. Mr. Haas' invention, therefore, reduces the effort of merely following the right path by a percentage which cannot easily be calculated. It is our intention to publish Mr. Haas' invention with full plans and specifications in the August issue of the POPULAR SCIENCE MONTHLY.

Both Mr. Butterworth and Mr. Haas are to be congratulated on the success of their ingenious ideas.

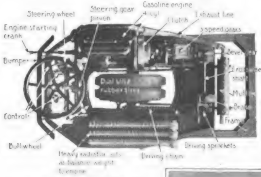
Maybe you have special needs. Write to the editor about anything within the scope of the magazine. He will be glad to help you.

A One-Wheeled Motor Tractor

A concrete illustration of how the difficulty was solved of making one wheel replace two

THAT a one-wheeled tractor possesses certain real conveniences over a two-wheeled affair has long been recognized, but the problem of working out the practical difficulties encountered were many and not easily overcome. The accompanying illustrations show an ingenious solution of this problem, and give a comprehensible demonstration of how the various difficulties were overcome. Some

For hauling guns over narrow trails or broken ground this tractor would be better than army mules



Showing the interrelation of parts in the one-wheeled tractor, and its compactness

of the problems encountered were the difficulty of transmitting the power from the engine to the driving wheel without a heavy and intricate system of gearing, of gearing down the engine revolutions in order to give greater power at the driving wheel, of providing means for changing the gearing as the conditions of load or road might demand, and, finally, of getting all these mechanisms into a compact space and of making it possible for the wheel to turn a complete circle of three hundred and sixty degrees in order to meet abrupt turning conditions.

All of these problems seem to have been solved in the one-wheel tractor shown on this page, the various mechanical contrivances for power transmission and gear-shifting being shown in the diagrammatic picture, and the attachment of the tractor to a fire-engine being pictured in another. The illustration at the top shows how the tractor could be made to do its bit in the game of war by hauling guns over roads not passable by larger motor vehicles.

The model has a four-cylinder gasoline engine, three-speed gears, a heavy radiator, and every part of the mechanism heavily reinforced. The tires are solid rubber.

The old fire engine is attached to the tractor simply by changing from the pole and whipple-tree to a yoke

An Ideal Industrial Locomotive: No Smoke, No Steam, No Coal

WITH coal scarce and gasoline high-priced and much in demand for all of our war activities, the oil-fired steam locomotive, burning heavy grades of distillate or crude oil, is now winning favor in plants where switching engines haul goods over short distances. The oil-fired locomotive has many uses. It is found hauling logs in camps far away from coal supplies; or wending its way on sugar plantations; or busily transporting from the excavations for New York's new subway system muck, rails, ties and ballast. Contractors select the oil-fired locomotive because it does not pollute the atmosphere with smoke.

Note the oil-tank in front of the boiler, which replaces the cumbersome coal-tender

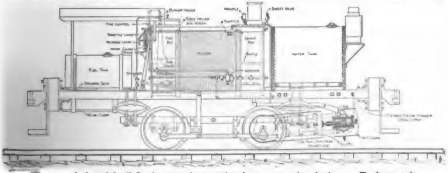
In appearance, the fuel-fired locomotive, as shown in the accompanying illustrations, does not differ much from the familiar coal-fed type, except that a separate tank out in front of the boiler takes the place of the usual coal-tender. The cost of operation is said to be less than one cent a ton per mile. The construction is clearly shown in the accompanying cross-sectional view.

Death Traps in Seemingly Unoccupied Fields at the Front

THE precautions taken by the officers of the allied forces in order to prevent their men from falling into German traps during the excitement of an attack are brought out in a statement made by Major-General Charles M. Clement, of the United States Army, who visited the firing line in France.

"When I studied army tactics some years ago," he said, "we had five points, represented by the five fingers of our hand, and there was nothing said about killing anybody. But an army order today reads: 'The object of this attack is (*a*) to kill the Germans; (*b*) to reach hill number so-and-so; (*c*) to stop at hill number so-and-so'; and woe betide the man who goes beyond the stopping point!"

These explicit instructions were given, General Clement explained, because the enthusiasm of the French and British soldier frequently urged him beyond the objective; and fields back of that, which appeared to be unoccupied, often proved to be cleverly camouflaged death traps.



The new industrial oil-fired steam locomotive in cross-sectional view. Each part is plainly indicated, showing the compact construction of this coal-saving iron horse

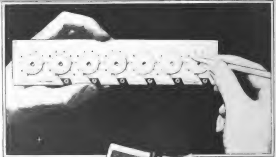
---

Those of us interested in science, engineering, invention form a kind of guild. We should help one another. All the specialized knowledge and information of the editorial staff of the Popular Science Monthly is at your disposal. Write to the editor if you think he can help you. He is willing to answer questions.

Inventions to Reduce Muscle Work in the Office

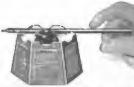
A blotter book for letters. They are blotted after being signed, by turning the leaves. This does away with the blurring of the signature when letters are turned over on one another

A tray for checks and deposit slips to keep them from becoming scattered while the clerk posts them

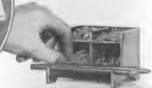


A computing machine with seven adding wheels worked by hand with a pencil point

Below is shown a six-sided ink-well holder made of paste-board, on which the calendar is printed



A holder is shown below for small desk conveniences, such as clips, pins, rubber bands, etc.

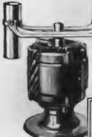


Six clerks, at this specially equipped table, handle 6,000 Pullman-car reservations daily

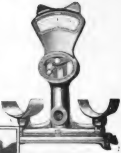
In the circle is a loose leaf pass-book in which entries can be made by machine or pen

A railroad company uses this itinerant bank to pay off 2,500 employees a month

Do It by Aid of These Labor-Saving Tools and Machines



This electrically driven centrifugal milk separator is a great help in making tests of butter



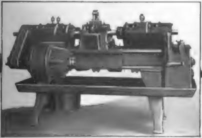
Scales which register the accurate weight of shells and shrapnel

The upper center picture shows a belt conveyor for loading crushed stone, etc., into cars

The center picture shows a railway tie with a wood block and asphalt cushion base to take up shocks

An inspection bench with gages and devices for careful measurement of artillery shells

The portable radial grinder shown below is used for general light grinding and buffing work



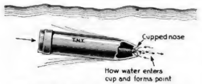
The boring, reaming and facing machine shown at the left does accurate work on automobiles

Sinking U-Boats with a Sub-Sea Barrage

The Isham shell, which does not ricochet, is the latest destroyer of the submarine

By Robert G. Skerrett

THE diving shell is the latest thing for attacking hostile submarines. It is the depth-bomb improved and therefore more potent. Indeed, in the opinion of many experts the diving shell is the most formidable instrument yet devised for battling with the foe's U-boats. It is an out-and-out American invention and the climax of years of study and development on the part of its originator, Willard S. Isham.



High-angle firing makes the shell strike the water at such an angle that it will dive into the sea instead of ricocheting

Of depth-bombs there are several sorts, but of diving shells there are only two kinds—a foreign adaptation of the Isham missile and the Isham projectile, pure and simple. The reason for this is that the French and British governments have been more alive to the merits of the American invention than our own ordnance officials, and, as a result, have actually been the first to apply the diving shell to wartime service. We are catching up, however, if reports from Washington can be accepted at their face value, and the so-called "non-ricochet shell" is likely soon to have its place in the magazines of all of our destroyers operating in European waters.

High-Angle Fire and Its Drawbacks

The British and French vessels that are armed to throw their form of diving shell resort to high-angle fire, the projectile traveling a course much like that of a missile discharged from a mortar. In this way, the shell strikes the water at an angle sufficiently blunt to obviate ricocheting and to insure penetration into the sea. Once the missile has plunged beneath the surface its explosion is automatically regulated. The detonating fuse is set to operate at a predetermined submergence as in the case of a depth-bomb.

High-angle fire from a moving craft at an object in motion has a number of drawbacks. First, there is the comparatively protracted flight of the pro-

The explosion of the Isham shell beneath the surface is regulated automatically by a time fuse set to operate at a certain degree of submergence regardless of hydrostatic pressure

jectile; second, its prolonged exposure while in the air to the deviating sweep of the wind; third, the fact that a slight roll of the gun platform will greatly change the arc of travel and, therefore, the range of the shell; and, finally, that the target offered by either the periscope or the conning tower of a submarine under way is a mark that is very hard to "range" accurately. These points are mentioned in order to emphasize the advantages of the Isham type of diving or torpedo shell which can be fired over a flat trajectory like any ordinary projectile from a naval gun.


The missiles fall all about the U-boat and form a veritable subaqueous barrage—an under-water curtain of fire

The Isham torpedo shell was originally intended to attack the under-water body of an armored ship and thus to reach her vitals. In the invention's present form we see a shell especially and peculiarly suited for battling with U-boats at long range even though the enemy craft offer but the smallest possible mark—the exposed tip of a periscope. Three years ago the Isham shell was tested by a board of naval officers, and while the fuse did not function satisfactorily in its entirety it showed even then that the designer was working in the right direction. The projectile, however, demonstrated that its author, by employing an unusual type of nose, could make the shell dive, on striking the water, and thereafter pursue a submerged course at a gradually increasing depth below the surface.

It Dives and then Explodes

The trial board reported that "a high explosive shell is an urgent necessity for naval use in addition to the armor-piercing shell now adopted." And the same commission stated:

"It would be highly desirable to have a high-explosive shell having a fuse such as has been suggested by Mr. Isham, viz, to detonate a shell on striking thin metal, such as the side of a destroyer, but which in striking water would not detonate until after a period of approximately a second—this in order that a shell which struck short of a ship might continue its run under water and explode on contact with the under-water body or near it."

Since that time, Mr. Isham has developed a fuse that he declares will do all of the foregoing things and more, i.e., it will explode after a certain time, following a dive, even should it fail to meet an obstacle in its path, and if it hit a solid body, whether thick or thin, it will burst within one hundredth of a second thereafter.

When the projectile impacts with water the momentary checking of its speed fires a time element or "train" of powder which must be consumed before the flame reaches the primer which actually detonates the high-explosive bursting charge. If it hits either thin or thick plating, a percussion cap instantly sets off the principal mass of high explosive. Hydrostatic pressure does not interfere with the functioning of the fuse. The moment a submarine is seen from afar, the gun will be loaded with the Isham projectiles and hurled at the foe, the missiles forming a veritable subaqueous barrage and creating an under-water curtain fire one or two hundred feet short of the target, so that the shells may strike the body of the submarine and explode or, failing in this, be detonated like so many mines near by and wreck the undersea craft.

© Western Newspaper Union

This apprentice machine is named after the penguin because, like that bird, it can skim along the surface of the water, but is unable to fly. It is safe for the inexperienced aviator

The Penguin Seaplane—It Swims But Doesn't Fly

Do you know what a penguin is? You may have read of it but probably have never seen one. The penguin is an aquatic bird found in the polar regions. It is remarkable for its peculiar structure. It has only small stumps in place of wings and, for that reason, is unable to fly. But it is a good walker and an expert swimmer and diver.

The name of "penguin" has also been given to the training apparatus employed to teach prospective aviators the control of the airplane or seaplane. The name is well chosen. The penguin used for training is as unable to fly as its arctic namesake. It consists of an airplane with wings so small that the power of the motor is unable to lift the airplane off the ground or water. It is supplied with ailerons, elevator, rudder and wheels exceptionally strong for running on the ground. The apprentice is enencouraged to run this "penguin" to his heart's content; there is no danger that it will take to the air. In a short time he graduates to a real airplane that can and does fly, and then he can give all his attention to the flying part without having to worry over the handling of the various controls. The sense of safety he enjoys while learning is a great nerve-sedative to the inexperienced aviator.

This Baby Caterpillar Tank Looks Dangerous But Isn't

The miniature caterpillar tank shown in the accompanying illustration is not an instrument of war, nor is it intended to become one. It was made at the request of the Red Cross organization of Stockton, California, by a local manufacturer of caterpillar tractors, to be used as an attraction in a society circus, which netted nearly $10,000.

The exterior of the tank was patterned after the English tanks used on the battlefield. A motorcycle engine was put in to supply the power for the motion of the track chains. It was so arranged that either side could be disconnected or worked independently, thus permitting sharp turns.

A one-man tank built like one of the big English tanks, but intended for a less bellicose purpose

Deep-Sea Fishing with a Little Submarine

EVERY fisherman knows that some of the most desirable fish to be found in the ocean never run closely enough to the shore to be caught with line or net from one of the piers. These fish like deep water and the fisherman who wishes to catch them must go out to seek them in their haunts. That means a trip in a tug or a seaworthy launch, which is not always feasible.

F. H. Trimble of Los Angeles, California, has devised an original method of deep-sea fishing without leaving the shore or pier. He constructed a small boat, built somewhat like a submarine, equipped it with a small motor run by a battery stowed away in the hold of the little craft and installed a simple clockwork that shuts off the current after a certain time. The little boat, built of steel and weighing about twenty-five pounds, is driven by a small propeller at about four knots an hour. It runs on top of the water or underneath the surface.

© Underwood and Underwood

My son, you may go out to fish, but don't go near the water

To this boat two lines are attached. One line carries the hooks and bait, while the other line serves to pull the boat back to the shore or pier. The fisherman baits the hooks of his line, attaches it to the submarine and starts the little motor. The boat makes a bee-line for the deep-sea fishing grounds, taking the baited line with it. When it has reached the desired place, the clock shuts off the electric current, and the motor stops. When the fisherman thinks that every one of the hooks has its prey, he pulls in the line, hauling back to shore the boat and fish.

Breeches for Parachuting

IN order to check the constantly increasing number of fatal aeronautical accidents a humane inventor has patented a pair of parachute breeches. Will they prevent your being dashed to the ground? We don't know. The fabric, cut, and workmanship are matters of choice, and your tailor will be pleased to suit your particular form and taste.

For those who intend to be measured for a pair of parachute breeches in the near future, we give a list of instructions which should be followed when you find it necessary to use them:

1. Remove your dining-room table.
2. Lay the parachute open on the floor.
3. Fold back the larger one and insert your legs in the smaller one.
4. Pull up and buckle trousers.
5. Adjust shoulder straps.
6. Tighten garters.
7. Gather all folds and swish them around to your back. Allow the train to trail on ground.
8. When you want to fly, give a quick jerk.

Don't go parachuting unless you are equipped with the proper kind of breeches

How Inventions and Machines Speed Up the Work of the Red Cross in New York

Photos by Courtesy of American Red Cross

Simplifying Sweaters

One day a man got tired watching his wife laboriously knit a sweater. "Too slow, my dear," he said; then went out and made this device. It worked so well that the gratified wife gave it to the Red Cross

A New Cutting Machine

Cutting garments for war refugees. In the Red Cross workroom where this electric cutter is used 250,000 yards of cloth are cut each month. It will cut through some 200 thicknesses of cloth at once

Making Clothes for Refugees

Another scene in the Red Cross workrooms where garments for war refugees are made. The machine on the left is spreading cloth on ninety-foot tables at the rate of 1,000 yards an hour. On the right machines are shown cutting the cloth into garments

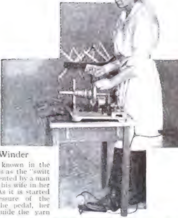
Winding Wool on Bobbins

A device used in the Red Cross model workroom for winding a hank of wool on bobbins so it can be handled easily when used on knitting machines

A Measuring Table

A table laid out in squares. Red Cross workers can be sure of making surgical dressings according to [illegible] chart for correct measurements

And Make Easier the Work of the Devoted Women Who Take Care of War Sufferers



The Swift Winder

An electric winder, known in the Red Cross workrooms as the "swift winder." It was invented by a man who wished to assist his wife in her Red Cross work. As it is started and stopped by pressure of the worker's foot on the pedal, her hands are free to guide the yarn

Making Patterns

An electric machine which perforates the patterns used by the Red Cross. The chalk, dusted through the perforations, makes an outline of the pattern on the cloth. Such strong material is used for the patterns that once perforated they may be used over and over again

Unwrinkled Gauze

An ingenious device for folding gauze in required lengths. It keeps the material perfectly smooth so surgical dressings can be cut in accurate widths and lengths according to the requirements

A Sweater Machine

A new electric sweater-knitting machine which has found great favor in the eyes of Red Cross workers. It knits a sweater in 14 minutes

A Dressing Frame

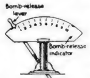
A frame which keeps light dressings in place. Workers can accomplish more work in less time by using this device because their material is always where wanted at the moment when quick work is imperative

The Hawks of the Royal Flying Corps

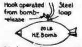
What contact patrol means in the fierce fighting on the western front

CONTACT PATROL—"A flight of one or more planes over the lines to give General Headquarters information regarding the position of Allied and German troops and also to take offensive action against enemy troops on the ground."

The average reader who sees this definition probably concludes that contact patrol is as uninteresting as it sounds. Definitions are never as thrilling as the things they define. Any fine morning on the sector of the western front held by the British you will find back of the lines at the Royal Flying Corps' airdromes, squadrons of planes preparing for contact patrol work. The airplanes used are generally of the same type (the F.E.2.B. "Pusher"), two seaters with one hundred and twenty horsepower Beardmore engines. While not particularly fast, these planes are easy to handle. Because their work is done mostly at a low altitude, they are slow climbers. It takes them about twenty-five minutes to climb ten thousand feet, but in straightaway flight they can do about one hundred miles an hour. With the motor throttled a contact patrol machine will glide sixty miles an hour, which is possible because the plane has a nice gliding angle. The armament consists of one down-pointing Vickers machine-gun, fixed alongside the fuselage or body and operated by the pilot, and one Lewis machine-gun operated by the observer. This Lewis gun can fire up or down and also straight ahead. The motor is in the rear, so that it cannot interfere with the firing of the gun. Under the fuselage are suspended several bunches of steel arrows; also two 100-pound bombs, or ten 20-pound high-explosive bombs.



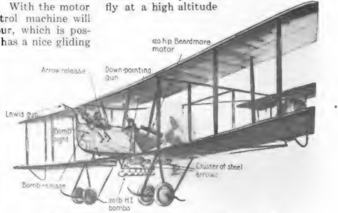
The turn of a lever releases a bomb. A slight miscalculation means a miss



This shows the hook to which the bomb is attached

They Carry Bombs, Armor and Machine-Guns

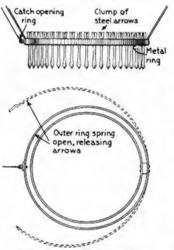
All these missiles of death are released from the observer's cockpit by a bomb-firing trigger attached to a bomb-sight. This bomb-sight is not used on contact patrol, as the airplane has to spend considerable time over an objective before it can be used. At a given height there is only one point of space where the airplane must be, if the bomb is to hit its objective. A miscalculation, no matter how slight, means a miss. When this happens, the aviator must turn his plane around and try once more to make the imaginary path of his machine pass exactly through the proper point. These repeated tricks are made for half an hour. The aviator must maneuver at will, unhampered by other planes. It is obvious that when the bomb-sight is used over a small area, a plane must fly at a high altitude



A "contact airplane" armed for its arduous duties, with machine-guns, steel arrows, and twenty-pound bombs

and alone. On contact patrol, planes fly very low and have done such effective work particularly with their machine-gun fire, that the Germans have found it necessary to dig bullet-proof trenches alongside the roads on which their troops march. At the alarm, the regiments dive for these trenches where they are comparatively safe.

Generally five planes are assigned to a contact patrol squadron. They fly in the usual V-shape formation. Once over the lines, their work commences. They remind one of hawks hovering over a chicken yard. Eagerly the pilots and observers scan the ground below, undaunted by the hail of lead poured up at them from machine-guns and "Archies."



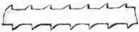
These arrows, dropping from a great height, have considerable penetrative force, but a steel helmet affords protection

What's That? A Regiment of Germans?

What the observers in the machine want to see most is a train or railroad or road-bridge. As soon as they see one, down they swoop. One after the other lets go a load of bombs and climbs again. The observers note the damage, etc. Suppose they see a regiment marching rapidly towards the front. In a fast glide, they descend almost on top of the startled soldiers. The machine-guns mow the Germans down, and often one plane of the squadron, flying higher than the rest, releases several clumps of the steel arrows. If there are no safety trenches at the side of the road, it is possible that almost the whole regiment may be wiped out. Should there be trenches, no doubt machine-guns will be hidden in them with the result that perhaps one or more planes of the squadron will be brought down by their fire. Hostile ammunition and gasoline depots, headquarters, railway junctions, detraining stations and aircraft hangars are all objectives for the pilots of a contact patrol squadron. It may be that there is a detachment of enemy engineers busily engaged in preparing the site for a new battery or building a bridge. If seen, rest assured that the planes will give them a warm reception.

Submarine Saws for Water Weeds

A SUBMARINE saw is used to clear weeds from irrigation canals on the project of the United States Reclamation Service at Orland, California. It is five-sixteenths of an inch wide, one-fiftieth inch thick, and the teeth are spaced seven-sixteenths of an inch apart. It is made of special steel in flat, flexible, tape form and has toothed edges. Two men, one at each end, operate the saw by means of ropes, starting at the lower end of the section to be cleared and working up-stream. The saw is placed diagonally across the stream, one man keeping slightly ahead of the other. It is held at the bottom of the canal by iron weights placed at intervals of about three feet. To remove the weeds, planks are placed across the banks, about six inches above the surface. Slanting wooden pieces project into the water forming a grating which catches the mown weeds.



The saw, from 150 to 300-feet long, cuts the weeds; a wooden grating collects them and a rake removes them

Plowing with Coal-Gas on English Farms

The scarcity of gasoline combined with its high cost compels this wartime measure in Great Britain

Soldiers operating a coal-gas-driven tractor and plow on an English farm

THE war is compelling the substitution of coal-gas for gasoline as a means of motive power for automobiles in England. Tractors carrying balloon-like containers in which to store the gas are not uncommon sights in the fields, soldiers being brought from the front to operate the machines.

But the employment of coal-gas is only a wartime expedient brought about by the scarcity of gasoline and its high cost. With the resumption of normal conditions after the war it is expected that gasoline will again come into general use in Great Britain.

The British Government decided in 1916 to restrict the use of gasoline, following the great demands made on the petrol supply of the country for war purposes. Then the question of obtaining an efficient substitute for gasoline came up. When coal-gas was being considered the difficulty of storing it had to be overcome.

In early experiments gas compressed in steel cylinders was employed, but there was trouble in reducing the pressure; hence the idea of a flexible bag to be carried on top of the vehicle was evolved. This bag was globular in shape and roped down. It was supplied with gas through a flexible sleeve, the connection to the engine being made by a tube with a control-flap within reach of the driver. This method of storage has had considerable popularity.

Showing the tractor plow, with power furnished by coal-gas, plowing furrows in the soil of England

A fresh supply of coal-gas being brought into the field on an English estate to operate a tractor plow

However, the bag, like the gas it contains, can be accepted only as a measure necessitated by the war, since it does away with metal cylinders. These are not practicable because of the great demand for metal.

A Tunnel Is Coming. On with the Fresh-Air Mask

LOCOMOTIVE engineers of trains which pass through long tunnels or snow sheds often suffer from lack of pure air. The smoke and the exhaust gases pollute the stagnant air in the tunnel and make it almost suffocating. To remedy this condition an engineer of the Southern Pacific Company invented a device which is shown in the accompanying illustration. A funnel fitting over the nose and mouth of the engineer is connected by means of a rubber tube with an air-pipe which runs to the main air reservoir of the air brake system. A small cut-out cock in the pipe permits proper regulation of the supply of air.

The engineer in this picture regales himself with pure air while his train runs through a snow shed

Fold Up the Propeller When You Want to Row

NAVIGATING small motor boats in the waters of Hudson Bay and the contributory rivers is not easy. Shoals mean frequent portaging. The situation has stimulated a Canadian inventor to bring out a small engine for rowboats, the propeller of which can be lifted up into the boat by the twisting of a handle.

In shoal water the propeller and shaft can be lifted out of harm's way into a water-proof metal jacket

The propeller is not situated aft, but amidships. The shaft protrudes through an encased slot in the bottom. The casing of the slot is proportioned so that, when the propeller is not needed, or when it drags bottom in shallow water, both propeller and exposed shaft can be lifted up out of the way of rocks and sand. The casing which is built along the center of the floor is water-tight. The toggle-jointed shaft from the engine enters it at the forward end through a water-tight journal.

The propeller and shaft are ingeniously brought inboard by a lever, the handle of which is situated conveniently on the outside of the metal casing. The handle works a pivot which communicates with the inner side of the casing.

This Isn't the Only War Which Has Caused Prices to Soar

IN these days of tribulation, when everything rises but father's wages, we all very consistently bemoan the high cost of living. But this is not the first and only time that prices have been high. During the Civil War wages ran from $1.12 a day for laborers, to $2 a day for skilled workmen. This, however, did not prevent a shave from costing ten cents, or a haircut twenty cents. Hotel rates were $1.50 to $2 a day, and ice, which was considered a great luxury, was supplied at fifty cents a week for ten pounds daily. Strangely enough sugar was the chief bone of contention in those days, too, and it cost twelve to fifteen cents a pound.

This "zigzag platform" facilitates the loading and unloading of vehicles, making it possible to load and unload from sides and ends simultaneously, besides occupying far less space

A Compact Zigzag Platform for Loading Wagons

LET us introduce you to the zigzag-edge platform. Although its name suggests associations of Coney Island, it is a misnomer, for this platform was designed for use in staid mercantile pursuits. It will be employed, in fact, to facilitate the loading and unloading of vehicles.

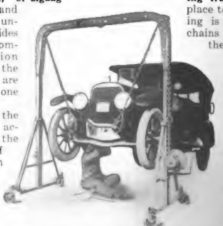
An excellent idea of the platform can be gained from the statement that its loading and unloading edge has a "sawtooth" formation, the spaces between the "teeth" being large enough to back in vehicles. The "teeth," or zigzag edges, allow wagons and automobiles to be unloaded from their sides and ends, as the accompanying illustration shows. The sides of the notches, of course, are at right angles to one another.

In addition to the advantage of easy access to and from the sides or the backs of vehicles, the platform decreases the extent of projection into the roadway of wagons, and apportions a definite amount of space to each.

Getting Under Your Automobile by Hoisting It Up

NOT only makers and repairers but also private owners of automobiles will be interested in the hoisting frame for automobiles invented by J. A. Weaver of Springfield, Illinois. The accompanying illustration clearly shows the simple construction of the device. It consists of a rectangular steel frame, strongly reinforced and resting upon braced bases placed at right angles to the plane of the frame. Ball-bearing casters under the bases make it possible to move the hoisting frame easily from one place to another. The hoisting is done by one or two chains running either over the pulley in the middle of the top of the frame or over pulleys placed in the corners. The chains are wound by a hoisting mechanism operated by a worm drive.

The device is strong enough to hoist with perfect safety any make of pleasure automobiles. One great advantage of this device is that it requires little space.



This hoisting frame does away with the objectionable cleaning - pits in garages

Signaling System Is Employed in American Barrage

SOME details of how the American troops in France lay down a barrage before an attack is made by infantry are related by Major-General Charles M. Clement, U. S. A., who has returned from an inspection trip to the front. A somewhat elaborate system of signaling is employed in connection with the barrage. This system is changed daily in order to frustrate the efforts of spies. The width of the barrage varies, and the fire is made intensive or light, depending on whether the men move backward or forward.

The cave probably marks the place where a boulder dropped out of the surrounding snow

This Submarine Raises Money Instead of Killing

THIS is the story of a submarine that invaded Scarborough, England, penetrating the very heart of the city without causing the loss of a single life. Furthermore, it was the means of helping to raise $500,000.

It was at first planned to have an undersea craft anchor in the harbor in order to spur persons to give to the fund. This idea being found impractical, a streetcar submarine bank was built. The actual work consisted in transforming the vehicle into a submarine on wheels. The members of the crew shown in the accompanying illustration are Scarborough "sea scouts," each of whom has been on vessels torpedoed by German submarines.

This submarine took money instead of lives when it invaded Scarborough, England, to aid in raising $500,000

Nature Carves a Queer Snow-Cave in the California Sierras

THE accompanying picture is a June snow-scene in the high sierras of California. During the progress of a government survey the engineers found the peculiar cave formation in the end of a bank of snow which was rapidly melting away under the rays of the sun. It is not known how the cave was formed, but it is believed that it contained a big boulder which, when it became warmer, dropped out of the crust of snow enclosing it and rolled down the mountain side.

Forts Built by Vauban Are All That Remain of Ypres

THE only things left standing in Ypres after the German attacks are the forts built by Vauban early in the seventeenth century. This was one of the comments made by Major-General Charles M. Clement, U. S. A., regarding conditions that attracted his attention on the firing line in France. He relates that in these damp forts two British commanders lived during months of warfare. It is queer that a seventeenth-century fort should survive a twentieth-century bombardment.

Teaching Machine-Gunners to Fire at Art

How paintings worth thousands, the work of famous artists, are used to develop skill in gunnery

By John Walker Harrington

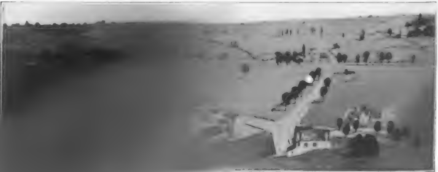
EVERY war has called in artists to help the fighters. Michelangelo, Leonardo da Vinci and Benvenuto Cellini did their bit in their time, and now come the Academicians of our own day, whose ambition it is to paint landscapes at which soldiers will be glad to aim either cannon or machine guns. These scenic targets are works of art in every sense, for they must come from the skilled hands of masters of perspective and atmosphere and must be so ably composed that they serve just as well as long reaches of hill and dale and rolling uplands. The Art War Relief, an organization which has been enlisting noted painters for this all-important work, announced that the canvases of students and amateurs were not available.

Artificial Landscape Targets

Most young men are city or town bred. Hence few of the soldiers of our national army have a clear idea of distances in nature. As many of the cantonments have not been placed amid scenery like that which marksmen are likely to see "somewhere in France" or "on the way to Berlin," artificial landscapes are provided on which they can practice. The paintings are too valuable for cannon fodder or even for machine-gun feed, but they serve wonderfully well in giving the illusion of panorama. The series which have been painted by H. Bolton and Francis C. Jones, both veteran members of the National Academy of Design, are typical of the kind of art which is now in league with war. Some of these pictures were used by machine-gun companies at Camp Upton near Yaphank, L. I., before their departure for overseas.

Distance and Proportion

As the machine-gunners "lay on" their pieces in front of this pleasing mark they must keep in mind two things—range and close designation. The middle distance in the painting carries the normal vision back about 2,500 yards. The mountains far in the background are supposedly eight miles away and therefore out of range. The canvas is covered with houses and churches, bridges and culverts, and even a winding stream. The gunners aim their weapons at these various objects. The commander comes up behind them and points out errors they have made in sighting due in part to their un-



to score. A faithful reproduction of a landscape
ce and proportion not otherwise easily acquired

Machine-gunners learn from artistic reproductions of the terrain how to judge of distance and of the interrelation of objects. Art with a capital *A* helps them to become experts

trained eyes and in part to their lack of familiarity with the mechanism.

How many men are there who grasp a description and act at once upon it? The officer gives the command, "Lay on black rock left clump of trees—three fingers!" Instantly the sergeant must repeat this order and see to it that the smooth barrel is so adjusted that it will guide bullets in the direction named. The quick understanding of the description of objects in a landscape can be developed by the use of the imitation terrain of paint. The firing of machine guns effectively is quick, sharp work and all the training of eye and brain which can be imparted stands the soldier in good stead in an emergency.

So exact are these high-art targets, owing to the co-operation of the military authorities and the designers, that even the complicated problems of strategy can be solved quickly by their use.

Grain Field a "Nest of Death"

After the marksmen have become more experienced they are assigned to devising ways for routing snipers out of hidden retreats supposed to be in all these mimic landscapes. The purpose is always to kill as many of the enemy as possible with the smallest amount of ammunition. Assume that there is in the center of one of the painted transcripts of nature a waving grain field, all golden in the sun, and enveloped in a mellow haze, as an art critic might see it. The machine-gun captain considers it as a yellow nest of death in the midst of which are certain big and deadly wasps, the stings of which are laying low comrades of another command. He cannot see exactly where the buzzing pests are straddled, but no time is to be lost. He gives the command to "traverse the field," which means that his gunners so divide the whole expanse of nodding stalks among them, that the zones reached by the rain of bullets account for every square foot of the suspected area. The variation of fire is made by causing the individual gunners to tap their pieces gently, so that a difference of two inches at the end of a barrel becomes a large space with the widening angle reached in a distance of a mile or so. The method of tapping can be learned readily in front of one of the brush creations and a man who is quick of eye and hand may soon become very proficient.

Useful in Estimating Trajectories

The counterfeit countrysides serve just as well as the real ones in estimating trajectories of projectiles intended for a certain locality and in the mastering of much of the theory of gunnery practice. The mistakes of the tyro can be constantly corrected. As the canvases are becoming more and more exact in their proportions, they are considered already as among the indispensables. A British officer on seeing some of these examples of American skill at Camp Upton recently, remarked that if the Allies had had as good ones they would have been able to have killed more Germans.

Using his derby hat in lieu of a tripod in order to get a coveted photograph

A Derby Hat Used in Place of Camera Tripod

A PHOTOGRAPHER desiring to make photographic copies of certain paintings in the Corcoran Art Gallery, wrote to the superintendent of the institution and received the necessary permission, but upon arriving at the gallery he found that they did not permit tripods to be erected upon the marble floors.

Not to be outdone, he used his derby hat, which, inverted and crushed in a little, balanced very nicely on the large mahogany rails in front of the pictures. Upon this he balanced his camera and, with a little care in focusing, using the rising front to give the proper perspective, managed to get the long-time exposures required by the soft lighting. The scheme worked perfectly and the copies desired were obtained. This method may be used for exteriors as well; but the photographer should be close at hand to look out for his camera in case it should overbalance.

Handless—And Yet He Is a Champion Billiard-Player

GEORGE H. SUTTON, the veteran billiard-player, has demonstrated to the world that a man may become an excellent billiard-player without hands. Sutton lost both hands when a boy by coming in contact with a circular saw. This did not prevent him, however, from taking up billiards, first as an amusement and later, when he had acquired remarkable skill in the manipulation of the balls, to enter the class of professional "short-stops." In a match game during the past season he made a high run of 113 in 18.2 balkline billiards.

Sutton uses no attachment to hold his cue. By patient practice he has acquired such marvelous skill in the use of the flexible muscles on the stumps of his arms, that they supply him with a good substitute of the "wrist-movement" so essential to good playing.

Many armless men and women have learned by painstaking practice to make use of their feet for writing, piano-playing, etc., but there are probably no parallel instances on record where a man deprived of both arms has become an expert billard-player by the use of his arm stumps.

A seemingly impossible feat — making a massé shot, holding the cue between his arm stumps

Handless billiard-player George H. Sutton making a carom shot with bridge

Photos © Int. Film Serv.

He Outswims the Ducks in His New Diving Dress

ON a recent gray Saturday afternoon, in London, the fussy little tugs and launches were puffing about their business on the Thames, and every now and then a lumbering Thames barge would pursue its unbeautiful bullying way down the river. The whistles were hooting, and a few gulls wheeled about, picking up scraps from the oily water—in short, it was just a regular, misty, gray London afternoon. Suddenly, though, there was a shouting and a craning of necks, and the sleepy river life became immediately wide awake. A man had jumped into the river from one of the boats. Was it an attempted suicide? Had he gone over to rescue some one? The black, murky waters swallowed him up. He bobs up. The river men could hardly believe their eyes. He had reappeared with a two-bladed paddle, and was propelling himself along! It all proved to be a demonstration of the new Davidson life-saving suit.

This costume is made on the same principle as a diving-suit. It is both air-inflated and waterproof. Air-chambers are provided in the body portion and in the leg portions, and these may be blown up by the mouth, through suitable tubes. The dress can be inflated in forty seconds. A belt around the middle, together with adjusting the amount of air in the various chambers, serves to regulate the equilibrium.

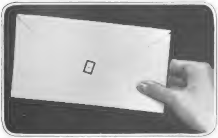
Properly inflated—but not with self-conceit—you can paddle yourself along comfortably in this union suit. All you have to do is to inhale as much air as possible, then exhale it through the tube into the costume. In other words buoy yourself up with your own hot air

This shows a man properly equipped for a trip that is apt to lead him into a temporary sojourn in the water. The suit is air-tight, and if he has enough breath left to inflate himself he can keep afloat for a long while

The Service Stamp is the Latest Patriotic Device

IN these days of rapid introduction of various kinds of new stamps it is not surprising to hear of the service stamp. These stamps are made in sheets of one hundred with one, two or three stars, as circumstances require, and are designed for use in the same way as the Red Cross seals. The cost of a sheet of one hundred stamps is negligible.

Affix one of these stamps to your letter, and thereby give your friend a hint that you have endeavored to fulfil your duty to your country; it is bound to be a reminder to him if in any small particular he has been remiss in that measure of duty which we owe our country.



The service stamp to be affixed to your letter to inspire your friends with your own sense of duty to flag and country

Chinese women cleaning the cab windows of a Southern Pacific Railroad locomotive in Oakland, California

Chinese Women Working on Railroads in California

IT is well known throughout the country that the people of the Pacific coast states take anything but kindly to Oriental labor. But at the present time there is such a serious shortage of white labor throughout the United States that even our Western brethren have had to down their prejudices and accept the inevitable. The Chinese coolie has long been a factor in the labor market of the West, but as a rule his consort has held aloof from manual labor. Now, however, a change has been wrought.

Nothing could better indicate how serious is the shortage of white labor in that part of the country than the fact that Chinese women are now employed by some of the railroads on the western coast.

An Alibi for the Bee in the Orchard

THAT bees injure fruit is a common belief in some quarters, but investigations recently carried out in Italy prove it to be without foundation. Bees cannot perforate the skin of fruit, and the damage attributed to them is really due to birds, wind, hail, hornets, wasps, and certain other insects. Bees are, in fact, of much benefit to the orchardist, because they effect the cross-pollination of fruit trees.

Mexican Corn Bins Look Like Old-Fashioned Sugar Loaves

AT first sight the objects that form the subject of our illustration look as though they were the twin spires of a sunken church. As a matter of fact they are corn bins on the Hacienda St. George, in Coahuila, Mexico. They are constructed of adobe or sun-dried bricks, and are plastered on the outside. On the plaster landscapes are painted in bright colors. One of the bins, it will be noted, is surmounted by a cross.

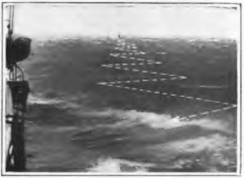
The corn is introduced through the little doors in the apex of the cones, and is taken out as required through the regular door.

Corn bins on a Mexican hacienda, shaped like sugar loaves, but made of adobe or brick, and brightly decorated

Wouldn't This Puzzle the Enemy?

A mine or torpedo that zig-zags under water to find its prey

A MINE which travels under water in a zig-zag fashion, somewhat like a drunken man on the sidewalk, and which therefore makes a terrible nuisance of itself, has been invented by a foreign officer, a noted authority on mines and explosives who is co-operating with the U. S. Government. The mine consists of two parts fastened together, but separated by a wall. One of the chambers, that in front, contains the explosive charge and has at its forward end the contact trigger which explodes the charge when it hits the object for which it is intended. The other compartment contains the motor and a mechanism which alternately drives first one then the other of the two propellers, thereby giving to the mine a zig-zag course, but tending in the general direction of the objective point, while crossing and recrossing the medial line at oblique angles. It is the theory of the inventor that by this zig-zag motion the chances of the mine's hitting the objective are greatly increased. A weighted keel maintains the mine in the desired depth under the surface and also prevents its rolling. As it may sometimes be desirable to drive the mine at a different depth, the keel is removable and may be supplanted by a heavier or lighter keel or fin, as the case may require.

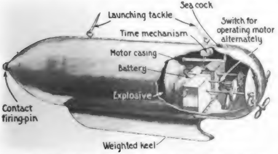


This picture shows the zig-zag path which the new submarine mine follows in its under-water course

Any kind of explosive may be used in this mine, but the inventor favors T. N. T., wet gun-cotton or dynamite, and also advocates the additional use of mono-nitro-naphthalene which, when the mine is exploded, gives off a dense black smoke, which will envelop the vessel struck and prevent signaling, repairs or rescue.

As the presence of such a mine in the water constitutes a constant danger to shipping, provision is made to cause it to sink after a predetermined period. A timing mechanism opens a valve in the rear end of the mine, allowing the water to enter. The weight of the water causes the unexploded mine to sink to the bottom, preventing accidental discharge.

To propel the mine, each propeller may have its own motor, and the motors work alternately, or there may be but a single motor, the power of which is applied alternately to the propellers by an oscillating gear or otherwise. The invention permits of many non-essential variations.



The front part of the mine contains the explosive; the rear part the propelling mechanism and control

Worse Than the Shinplasters of Civil War Fame

A CURIOUS condition of affairs with respect to money prevails in the department of Nariño, the southernmost department of Colombia. This region is isolated by poor means of communication from the central government and has regulated its own affairs to a great extent. When the rest of the country adopted a gold standard Nariño refused to conform and enforced a local silver standard. As it accepts at silver value coins of all nations and dates it has become a dumping-ground for coins no longer current elsewhere.

He is not a millionaire's son. All this Colombian paper money is worth just one dollar. A paper peso is worth one cent

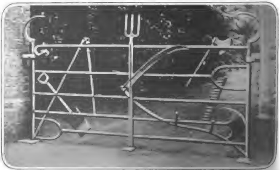
It is said that the most abundant coins are the old eight-real pieces of the early years of independence. A few years ago, we may add, the whole of Colombia was swamped with paper currency enormously depreciated. At one time it took 22,500 pesos of this paper to buy a United States gold dollar. The government has now issued a decree recalling the national silver coined before 1911 and all foreign money now in circulation.

Moon and Earth Help French to Aim Cannon

THE French engineers in the European war have reached a high degree of perfection in mathematics, according to Major-General Charles M. Clement, U. S. A., who made an exhaustive study of conditions on the firing line. These sappers of the French army have figured out the influence of the earth on a shell traveling out of a cannon, how much farther it will shoot north than south, and to what extent the moon will deflect the shot. As a result, what is described as the ultimate error of the cannon shot is being rapidly overcome. Moreover, if a commander is unable to point a cannon within ten feet of the target, he is not regarded as a success.

This Is a Farm Gate, No Doubt

PERHAPS it was his passionate love for farming, perhaps a dawning sense of art, or pride in the paternal acres which had come down to him through many generations of tillers of the soil, that induced the owner of a farm in Moulton, Northampton, England, to put the quaint gate shown in the accompanying picture at the entrance to the driveway leading to his farmhouse. Anyone who passes that gate will know that the owner of the estate is a farmer and so proud of it that he wants everybody to know it. The ornamentation is, to express it mildly, original in design and of striking appearance, but does not betray a high degree of artistic taste. However, it is symbolic of the farmer's calling, and who shall criticize?



An English farmer has decorated his gate with the various implements of his calling. If not artistic it is surely symbolic

The boilers contained enough air to keep them afloat while they were towed ashore. They were then encased in planks and started for China for duty in another ship

The ship could not be saved, but cargo, boilers, and machinery were taken out

How the Boilers of the "Bear" Were Salved

THE steamship *Bear* of the American Geodetic Survey stranded near Cape Mendocino, on the California coast. When it was found impossible to save the ship all efforts were confined to the salvage of the valuable contents, including the boilers and machinery. The machinery was taken apart and conveyed to the beach piecemeal. The large boilers, however, six in number, could not be taken to pieces, and their salvage was therefore attended with great difficulty. Each one of the boilers was eleven feet six inches long, thirteen feet six inches in diameter and weighed fifty-one tons. Each individual water tube was first plugged at each end to make it airtight. The air enclosed in the pipes and in the boiler was sufficient to keep the boilers afloat after they had been lifted out of the hold by a derrick and deposited in the water. The boilers were rolled on the beach, encased in an armor of planks, then set afloat again and towed twenty-five miles to Eureka, California, whence they were shipped to Shanghai to be placed in another hull.

A Lilliputian Rival of the Popular Wrist Watch

IF the ponderous old grandfather's clock, with its weights and wheels, could do so, it would doubtless raise its hands in surprise at sight of the ring watch, the smallest member of the time-keeping family. This tiny record-keeper of the minutes and hours adorns, and is adorned by, a finger-ring studded with jewels. It is shown in the accompanying illustration.

This watch is a composite timepiece, the works being of Swiss manufacture, and the case of New York make. The movement is smaller than a ten-cent piece and the case is studded with diamonds, even the winder being set with one of these precious stones. As a novel and attractive ornament this little watch is pretty sure to find favor with the fair sex, and it is possible that it may to some extent replace the wrist watch which has recently gained so greatly in popularity, especially among soldiers.

This little watch on milady's finger ring is a real, honest-to-goodness timekeeper

First Heal the Wounds, then Hide the Scars by

The First Step

Captain Derwent Wood, an English sculptor, has worked out a method of covering disfiguring scars by metal masks painted in life-like colors. The method is not new, but has been greatly improved by the sculptor. The first step toward restoring the patient's features consists in making a plaster cast of the parts to be covered by the mask. This is a great boon to the disfigured fighter, although he may well be proud of his scars

Almost Finished

The thin metal mask, having been carefully fitted and trimmed to the proper size and shape, is enameled and painted to match the color of the patient's skin. The picture showa Captain Wood with the almost finished mask in his hand, about to adjust it to the features of the patient before him. The means for fastening the mask are still lacking

The Rough Cast

The masks are made by an electrolytic deposit of pure copper upon a cast of the features as they are intended to appear. They may also be made of silver or of some alloy of silver and copper. In the picture Captain Wood is examining the roughly molded mask before it is trimmed, adjusted and finished by enameling and painting. Great skill is required in order to match perfectly the lineaments and complexion of the uninjured side of the face

Photos © Underwood and Underwood

The Finishing Touch

After all the preliminary work is done and the mask fully completed and provided with the means of fastening it, the patient puts it on and the sculptor, who is also a painter, puts the finishing touches to his handiwork. One of the most difficult problems is to obliterate the tell-tale border line where the mask and the skin meet. This is done by careful retouching of the painted surface. The manner of keeping the mask in place depends upon the conditions in each individual case. In this case it is held in place by a pair of spectacles

Covering Them with Artistically Shaped Masks

A Shell's Work

Although the work of Captain Wood is by no means confined to war injuries, the majority of his patients are men who were disfigured by more or less serious injuries received in the war. The picture below shows a young British soldier who was hit between the eyes by a shell splinter. See the transformation wrought by the mask, in the picture to the right

Only Imitations

The stock-in-trade of this human repair shop is of a varied nature. Masks in every stage of completion, ears, eyes, noses, chins or other parts of the features are the most common specimens in evidence. Spectacles are often employed as a convenient means of unobtrusively fastening the metal masks so as to cover the disfiguring scar caused by injury or disease

With the Mask

The picture above shows the British soldier of the picture on the left, as he appeared wearing the mask made for him by Captain Wood. It is held in place by the spectacle frame and completely hides the terribly disfiguring scar which the shell-splinter wound left between the young man's eyes. It is so perfectly made that it is almost impossible to see where the mask ends and the natural tissue begins

A Sculptor's Idea

The officer shown standing in the picture, palette in hand, is Captain Francis Derwent Wood, the English sculptor, who enlisted in the British army in May, 1915. He entered the hospital service and soon was placed in charge of the splint room of one of the military hospitals in London. His experience there suggested to him the thought that art could be of great help in extending and perfecting the efforts of plastic surgery. The government encouraged him and he was given an opportunity to develop his method

The lifting tackle travels on a track extended from loading room across track. One tackle performs the operation

Wafting Five Tons About as Though They Were Thistledown

"ALL ready below there?"
"Yep, let 'er come."

There is a whirr and the rattle of a running chain, and a huge packing-case floats airily out of a second-story window and smoothly descends towards the flat-car which is waiting below to receive it. "Easy now—bit further—whoa!—back a bit—*a-a-all* right."

That is about the sum total of the operation of loading a packing-case containing five tons of motor-truck onto the cars for shipment, at the plant of one of the big truck manufacturers in Michigan.

The reason for the ease with which the thing is done is due solely to an ingenious bundle-carrier that the company has installed. There is nothing very new in its essential parts, for it is the regular chain-and-pulley type of purchase, but the application to special conditions is very interesting. The track on which the lifting tackle travels is extended across the track and into the loading room too. Consequently the cases are moved around, swung out, lowered, and everything is done with the same tackle. Four boxes are loaded onto one car.

Formerly it took ten men a whole ten-hour day to do a single job, and inclined planes had to be built to load the upper boxes from, using rollers and crowbars. Now four men can load about forty-eight boxes a day, and, if necessary, one man does it.

This Moving Van Loads From the Side

HOUSEHOLD goods and pianos, as well as other things that had to be moved for some considerable distance, formerly went by railroad. Recent railroad congestion, however, and the difficulty of getting box-cars for anything that does not come under the head of war necessities, has brought home to many people the fact that it is often cheaper and handier to have their household furniture moved by vans. Even if it did cost a little more, there is a great deal gained in convenience, because the goods are actually taken right out of your own dwelling into the same van that conveys it to your new abode. But as a matter of fact, it is actually cheaper in many cases than to pay freight plus cartage.

As an aid to dispatch, a Los Angeles, California, moving man has equipped his truck-van bodies with side-moving doors that make it possible to load heavy pieces of furniture, such as pianos, right onto the van from the sidewalk. Formerly special tackle had to be used for doing this, so it is evident that a considerable saving in time and labor is effected.

Showing a side-opening arrangement whereby heavy goods can be loaded without aid of special tackle

© Int. Film Serv.

Uncle Sam's embryo soldiers obey the call to go "over the top" with all the will in the world — fit for a fight or a frolic as fate may dictate when they get "there"

Going "Over the Top" with the Soldiers at Camp Upton

THE accompanying photograph shows what the camera registered when the photographer took a snapshot of soldiers at Camp Upton while they were going "over the top"—which is only one feature of the physical training which the Camp Upton men undergo in preparation for the fighting "over there." Punching a bag with a bayonet to accustom the soldier to hand-to-hand struggles, foot races, boxing matches and other sports make up their life in camp.

A class at the naval training station at Newport studying the various parts of a ship

Photos © Western Newspaper Union

The science of "boxing the compass" is taught to the naval recruits by aid of this ingenious device

Learning to be a Blue-Water Sailor on Dry Land

THE training of a man-of-war's man is not a simple matter. In days gone by it used to take almost as many years as it now takes months. The methods of instruction and of training have undergone wonderful changes; they have become much more intensive and to the point, and the results obtained prove the efficacy of modern methods.

Stations for the training of the future sea-fighters have been established at many points. At these stations the young men preparing themselves for naval service receive the most careful instruction and training, theoretical as well as practical, and in accordance with the most advanced ideas. Nothing could emphasize more strongly the difference between the present method of training and that which was in vogue in the olden days. Then the men were drilled in the most primitive manner; a rope's end usually played an important rôle as an educational factor. Now, with the help of models, the men are taught in one hour what would have taken days, weeks or even months under the old system.

Driving Your Car Through a Stream of Oil

This new transmitter solves the dual problem of power-waste and leakage of oil

FLEXIBILITY of operation is the great outstanding factor of power transmission by means of fluids, so far as the automobile is concerned. Fluids transmit power through the pressure exerted by the fluid on the part to be moved. The fluid is pumped by some means into chambers containing the parts to be moved, and since the fluids used are practically incompressible, the degree of pressure exerted is almost proportional to rate of flow or the pressure represented by that flow. It is a simple matter to change the pressure by merely changing the rate of flow.

This may be done by ordinary control means and gives such a wide range of different speeds that when a hydraulic transmission is applied to an automobile, the latter can be run at the speed best suited to the conditions of load and road instead of the three or four speeds provided in the ordinary sliding-gear transmission.

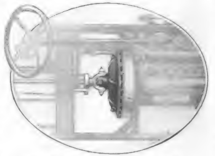
The hydraulic transmission supplies those speeds which the gear reduction cannot because the number of teeth in the meshing gears necessarily always remains the same. Again, the hydraulic transmission enables the pressure to be increased gradually from low to high speed. It also eliminates the clutch and does away with the attendant manual effort when changing speeds.

Parts of Power Transmitter

When engine is started, the blades of member attached to engine force oil against blades of housing mounted on propeller shaft, turning this and finally rear wheels. The oil flows back into a chamber at inner circumference of two housings, whence it again reaches blades of engine member, thus continually circulating within housings. Gentle flow eliminates the jerks caused by the clutch in ordinary cars

The hydraulic transmission of power in motor vehicles is not new. In some of the systems used a master pump is driven by the engine, and other smaller pumps drive the wheels, the oil reaching and leaving the smaller pumps through a series of pipes. Most of the pumps consume an excessive amount of power because of skin friction in the pipes or leakage of the oil. Sometimes both of these factors are combined.

Both of these difficulties seem to be solved in the power transmitter, which consists of a combination of a centrifugal pump and a turbine that can be inserted in place of the clutch in any car equipped with the ordinary gasoline-engine of the present day. There are no pipes. No changes need be made in the other power transmitting parts.



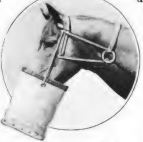
Showing the installation of a turbine as a substitute for the clutch

The turbine consists of but two moving parts, a driving member attached to the engine-shaft and a driven member, fastened to the front end of the propeller-shaft of the car. Both members are constructed exactly alike and are made up of two circular housings with blades or fins radiating from a central rectangular chamber. The two members stand apart and touch only at the bearings on the shafts. The space inside the housing is partially filled with oil. When the engine of the car is started, the blades of the member attached to the engine force the oil up against the blades of the housing mounted on the propeller shaft so that it, and finally the rear wheels are turned to make the car go. The speed of the car is controlled by the throttle, although the device may be thrown out of contact with the flywheel if it is necessary to shift the gears in the usual manner.

As long as motor-driven vehicles are used, the quest for improvements and labor-saving devices will go on, stimulated partly by economic dictates and partly by the inherent inclination in the human race to simplify mechanical contrivances.

Making It Easy for Old Dobbin to Eat Out of the Feed Bag

THE feed-bag support invented by William Meier of Jersey City, N. J., is designed to overcome the difficulties invariably connected with the use of the feed bag. This bag is provided with a spring so that it will adjust itself when the food gets out of reach of the horse as it diminishes in quantity. Even under the most favorable conditions part of the oats will be spilled in the horse's attempts to get at it. Mr. Meier's invention consists of a yoke-shaped frame of heavy spring wire, which is suspended from the head and neck of the animal in the manner shown in the illustration. The bag is suspended by a cord running through a loop of the spring.



The spring keeps the feed bag adjusted so that the horse can get at the oats

Practicing the Head-Hold with a Wooden-Headed Adversary

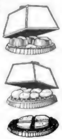
BOXING with a dummy which can't be knocked down is a well-known and recognized form of training for pugilists, but hitherto wrestlers have been rather unprovided for in this respect. Now, however, Mr. B. C. Sandow, of Rochester, New York, has brought out a dummy head to train a man to give enormous pressure in the head-lock.

This apparatus is a wooden, life-sized head, made in two equal pieces divided down the center of the face. The halves are kept apart by three coil springs. The wrestler practices squeezing the halves together, as he would in the head-lock, until he can conquer the tension of the springs.

"Strangler" Lewis, the famous wrestler, uses the dummy for exercise

A great cooker for campers, and a boon to the housewife in summer

You Can Carry It in Your Hand and It Saves Fuel



IT is expensive as well as uncomfortable, in warm weather, to use a gas oven when the same result can be obtained by using one of the burners on the top of the stove. But how can you roast on such a burner, you ask? The answer is found in an efficient cooker which has recently made its appearance.

The new cooker, built of cold rolled steel, consists of six parts—an asbestos-lined hood, a base with a removable heat deflector (also asbestos-lined), a perforated corrugated circular steel plate which acts as an equalizer for the heat, and a wire stand. Extra strength is obtained in the manner in which the corners of the base and hood are folded

When used as an oven the cooker bakes perfectly. It is large enough to bake two loaves of bread at once, a fowl or enough of any food sufficient for the dinner of an average family. The equalizer, used without the hood, is of great assistance in cooking or frying as it spreads the heat evenly under the pot or pan.

No Footprints Are Left by the Gasoline Lawn-Mower

THE lawns of the golf-club need trimming and the horse-drawn mower has been at work since early morning. Up the gentle slopes and down again on the other side old Dobbin is pulling the heavy cutter. When the blades of the mower encounter thicker grass, Dobbin slows up and the increase of resistance caused by a little hummock is sufficient to make him stop altogether, until a sleepy "Gidap" from the driver stirs him to a renewal of his labor. Streaks and holes appear at intervals, which invariably cause dissatisfaction on the part of the golfers.

Because of Dobbin's inefficiency a western country golf club decided to purchase the converted Ford motor lawn-mower shown in the accompanying illustration. It leaves no hoofprints, does not tear up the sod and pulls with such evenness that the grass is almost as smooth as the top of a billiard table. Besides, it does the work of two horse teams and at a smaller cost.

The tractor consists of a regular Ford runabout model with wide metal wheels in the rear. It is run on second gear when pulling the mower and is provided with a water pump to circulate the engine water properly at the continuous low speed. To prevent the water from being spilled out of the radiator when the tractor is going down sharp inclines, a gallon can it attached to the radiator cap as shown in the accompanying illustration.

Hitch your Ford to a lawn-mower and you will secure a velvety lawn without giving a horse nervous prostration

When the Moon Darkens the Sun

What astronomers will look for during the June total eclipse of the Sun

By Calvin Frazer

A TOTAL eclipse of the sun is one of the most awe-inspiring spectacles in the whole repertory of Nature. Its overpowering effect upon the human mind is illustrated by an episode which the present writer recalls in connection with the eclipse of May 28, 1900, as seen at Norfolk, Virginia. The weather was superb, and the town was crowded with visitors; besides whom the natives were all on the streets. During the period of about an hour following "first contact," while the disk of the moon encroached more and more upon the face of the sun, the spectators, white and black, kept up a lively chatter of conversation. Probably most of them found the phenomenon rather tame, and wondered why people should travel miles to see it. Just before the beginning of totality the light of day faded with startling abruptness, the beautiful solar corona flashed out, the stars appeared in the sky, and a ruddy glow, as of late sunset, encircled the horizon. The babel of conversation ceased instantly, and was succeeded by the *crash of breaking glass*. Totally unprepared for so marvelous a sight, many people, especially among the colored population, let fall the pieces of smoked or tinted glass through which they had been viewing the eclipse!

Renewed efforts will be made at the coming eclipse to solve the mystery of the flickering "shadow bands," which steal over the ground at the beginning and end of totality. Former attempts to photograph these "flickerings" were not successful

Interesting to the layman as a spectacular event, a total solar eclipse is even more interesting to the astronomer as a rare opportunity for obtaining fresh light on a wide range of scientific problems. Hence, in order to observe a process of Nature lasting generally only two or three minutes expeditions are organized and equipped at great expense, and sent perhaps halfway 'round the world to some favorable vantage point. After arrival, many weeks are spent in setting up and adjusting instruments and rehearsing every detail of the observations, so that the advance program may be carried out without a hitch at the proper time. Every precaution is taken to economize to the utmost the precious seconds available during the event.

After all these preparations, the astronomers in many cases get no results at all, owing to unfavorable weather. A single cloud may blast their hopes. The party sent from the Lick Observatory to view the eclipse of 1900 encountered a citizen of Georgia who was frankly skeptical about their ability to foretell the occurrence of the eclipse, and his doubts deepened to positive disbelief when he heard the observers anxiously speculating about what the state of the weather might be on the eventful day. "These young men," he said, "try to tell me they know the sun is going to be eclipsed, and they can't even tell whether the sky is going to be clear!"

Unfortunately the only help the meteorologist can give to the astronomer in this matter is to tell him what the average weather has been in previous years on the

...rious Corona in Total Eclipse

Photograph by Yerkes Observatory

When the Moon Masks the Sun's Face

Only during the fleeting minutes of a total eclipse may the Sun's weirdly beautiful Corona be seen. It is a pearly white glow, like a halo, which extends in an irregular outline millions of miles into space. Photographs will be made of the Corona, as usual, to determine its size and outline, which varies a great deal from one eclipse to another and [illegible] to be related to the frequency of the [illegible] It is hoped also to obtain good [illegible] tures of the total solar eclipse on June 8, [illegible] and many problems hitherto not [illegible] are expected to receive clarification at [illegible]

date in question, and such information always plays an important part in the selection of sites for eclipse observations. Generally speaking the chances of favorable weather are best along a line from eastern Oregon through Idaho and Colorado, and this will be a favorite part of the track for the further reason that the sun will be higher in the sky at the time of the eclipse than farther east.

The world over there are about 70 total eclipses of the sun in the course of a century, but at any one place on the globe there is, on an average, only one in about 360 years. In the whole present territory of the United States (outlying possessions not included) there were only eight total solar eclipses during the nineteenth century, and there will be the same number during the present century: viz, in 1918, 1923, 1925, 1945, 1954, 1979, 1984 and 1994.

A Case Where the Moon Obscures the Sun

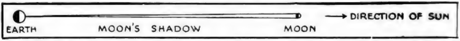
The fundamental facts relating to a solar eclipse are quite simple. The moon, in her monthly revolution around the earth, occasionally passes between us and the sun. The moon has no light of her own, and when she shines it is by reflected sunlight. In a solar eclipse her unilluminated side is turned toward us, so that we see her as a black disk, intervening in front of the sun. The reporters who write up scientific events for the newspapers often refer to this disk as "the shadow," through confusion with eclipses of the moon, in which the darkening is due to the shadow of the earth. What we see is not a shadow, but the moon itself. The sun's diameter is about 400 times as great as the moon's, and the sun's average distance from the earth is about 390 times that of the moon. The attached diagram, which is correctly drawn to scale, shows the long, tapering shadow cast by the moon as she revolves through space, and shows why there is only a small area of the earth's surface from which, at any one time, the sun is completely hidden by the moon. Owing to variations in the distance of the moon and the length of her shadow, there are some eclipses in which the latter does not reach all the way to the earth. Under these circumstances an observer directly in the line passing through the sun and moon sees, at the time of eclipse, a circle of sunlight extending all around the lunar disk, and the eclipse is said to be "annular."

The Moon's Shadow a Fast Traveler

The shadow cone on June 8 will first touch the earth at sunrise in the Pacific Ocean, not far south of Japan. Thence it will sweep eastward, entering the United States in southwestern Washington at 2:55 P. M., Pacific Standard Time. It will then be traveling at a speed of 33 miles a minute. Striking southeast, it will cross the Mississippi River at 5:37 P. M., Central Time, reach the coast of Florida at 6:42 P. M., Eastern Time, and leave the earth after reaching the vicinity of the Bahamas at sunset. The actual time required for the journey across the United States (from 2:55 P. M., Pacific Time, to 6:42 P. M., Eastern Time) will be 47 minutes. "Daylight saving" necessitates the adding of an hour to these times.

The coming eclipse will be observed by parties from all the leading observatories of America. But for the unhappy state of public affairs abroad, we should

The principal heavenly bodies, which will be visible near the sun during the eclipse. Although many astronomers have given up the hope that any planet or planets moving within the orbit of Mercury, the planet nearest the sun, will ever be found, the search will be continued during the coming eclipse

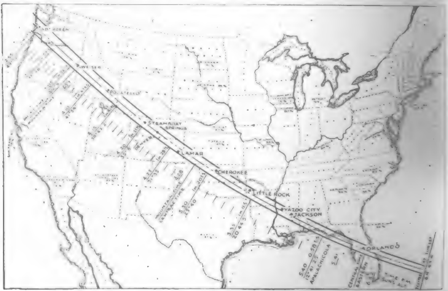


This diagram, drawn to scale, shows the earth, the moon and the moon's shadow during the eclipse. The distance of the sun is 390 times the distance between earth and moon

have had the privilege of welcoming scores of astronomers from Europe. One large American observatory the Chamberlin Observatory, at Denver—will not need to send out an expedition, as it is situated right in the path of totality. The unusual length of this path within accessible territory is a particularly favorable circumstance, for the reason that observers at western stations, after viewing the eclipse, will have ample time to telegraph to those at eastern stations, calling attention to any features that especially demand further observation.

By hiding the sun and cutting off the glare of sunlight in our atmosphere, an eclipse makes it possible for us to see the envelope of incandescent gases by which the sun is surrounded, known as the *chromosphere*. Beyond the chromosphere, and extending millions of miles into space, is a pearly white glow, of irregular outline, known as the *corona*. By means of a marvelous instrument called the spectroscope astronomers are able to see and to photograph the chromosphere and its prominences at any time; but the corona can never be observed except during a total eclipse. The spectroscope is also applied, while an eclipse is in progress, to a study of the chemical composition and the movements of these solar envelopes or atmospheres.

In past eclipses eager search was made, by photography and otherwise, for a possible planet, or planets, lying within the orbit of Mercury—the nearest to the sun of the planets now known—and observations of an "intramercurial planet" were occasionally reported. These observations were, however, undoubtedly erroneous and astronomers the world over have generally given up hope of finding such a planet.



About eighty-five towns are directly in the path of the total eclipse. Since we are saving daylight add an hour to the times on the map. The track of totality extends from Washington to Florida. Outside of this track, in a belt varying in width from seventy miles at its western end to forty-five miles at its eastern, a partial eclipse will be visible

Photograph by Yerkes Observatory

Great masses of glowing hydrogen are tossed up as far as three hundred thousand miles from what is called the "chromosphere," an irregular scarlet rim which will be seen surrounding the moon's disk. This rim, however, can also be studied even when there is no eclipse

Scientists Will Test New Theory

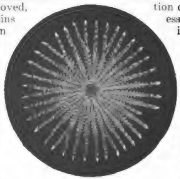
During the coming eclipse the region around the sun will be most carefully photographed for another purpose, and one which constitutes a novelty in eclipse observations. According to the new theory of relativity, which is now exciting so much discussion in scientific circles, there should be a very slight displacement in the apparent positions of stars seen close to the sun, owing to an attraction exerted by the latter body upon beams of light passing near it. This displacement will perhaps reveal itself on the photographic plates.

Other new features to be observed will be the effects of the moon's shadow on radio signals and the presence of electric waves in the atmosphere.

Something to Lose Sleep Over—Can Fish Hear?

CAN the humble minnow, or any of his larger brethren, hear? He has ears, but are they any use to him? Some scientists have experimented and said "Yes!" while others have experimented and said "No!" However, recent study seem to indicate that fish *do* hear.

Some of the fish experimented upon had their ears removed, and others had their skins made insensible. Then sounds were made in direct contact with the water, but without agitating it at all, and signs of hearing looked for. It was found that fishes are influenced by sound. One of the most peculiar and striking manifestations was the fact that a fish that had had its hearing organs destroyed lost its sense of direction when swimming fast. It could swim straight slowly, but as soon as it attempted to put on speed it went round in spirals. Considering that many species of fish travel considerable distances during their periods of breeding and depositing their eggs, such loss of direction would tend to make them easy prey for their enemies.



Crown of breathing hairs belonging to Chameleon fly larva

Crowns On Their Tails. The Queer Forms of Some Flies

"UNEASY lies the head that wears a crown," doesn't apply to the larvae of certain soldier flies; for their crowns are at the ends of their tails.

The adults (as one of our pictures shows) are rather stout-bodied, unfamiliar insects, although about as many species as there are horseflies occur in this country. They frequent the flowers in marshy places and derive their name from their brilliant coloring.

The larval period of different species is passed in the earth, in damp moss, decaying wood, ants' nests, fresh and brackish water. Some are believed to be parasitic in bee hives. To add still further diversity to their choice of breeding places one observer states that he found them in a hot spring in Wyoming, where the water was estimated to be but twenty or thirty degrees below boiling point—a decidedly close parallel to the salamander's mythical capabilities.

The particular one of this family which takes such decided liberties with the prevailing mode of wearing one's crown, is the larva of the Chameleon fly. In his case the crown is no mere decoration or emblem of rank, but an essential organ in his breathing mechanism.

His crown consists of about thirty many-barbed hairs radiating from a central disk containing two perforations for the outlets of the breathing tubes.

In the surface attitude the body hangs downward suspended by the crown of hairs, which crown lies almost flat on the water forming a very shallow funnel, allowing free entrance of the air to the breathing tubes. On leaving the surface, the hairs bend inward, enclosing a glistening bubble which serves to enclose air for breathing, while the little creature wriggles about among the mud and debris at the bottom of the pool in search of food. During the act of breathing the bubble contracts and expands.—CLEMENT B. DAVIS.

In the circle, the adult Chameleon fly. Below, two larvae, showing crown closed and open

Automobile or Railway Car—Which Is It?

A CALIFORNIA inventor has devised a method which will enable an ordinary automobile omnibus to run on railroad rails as well as on city pavements and country roads. It's an old idea, of course, but with modern "improvements." The Californian bolts a flanged railroad carwheel and a conventional solid-tired truck wheel together, with the rail wheel on the inside. The circumference of the solid tire wheel is larger than that of the flanged wheel. When running on a pavement of macadam the flanged wheel does not touch the ground at all. It comes into action only when the car is running on rails, as shown in the picture. Small wedges, placed alongside the track, permit the omnibus to run on or off the rails without difficulty. The system has been tried out on a suburban bus-line in California and has given good satisfaction. It enabled a California motor-bus company to open up new territory between Holtville and El Centro, between which there was no suitable road but a slightly used railway line. The bus picks up its passengers on the city streets and then runs to the railroad line over which it makes its trips. It will probably add a new word to the dictionary when some philologist shall succeed in constructing a term that fits this dual-service car. "Autorail Car," for instance, or some other suitable combining form indicative of the car's ability to change its nature at the will of its chauffeur or engineer, whichever title may be the proper one.

The wheels of this omnibus will run smoothly on ordinary railroad rails, city pavements or country roads

Extending the Use of the Sidecar

A MOTORCYCLE dealer in Riverside, California, finds the sidecar arrangement improvised by him to change ordinary motorcycles into delivery trucks very useful in his own business to carry crated motorcycles from the nearest distributing point, Los Angeles, to Riverside, a distance of fifty miles. The trip to Los Angeles and return is made in four hours and requires about fifty cents' worth of fuel, while the railroad freight on the crated machine would cost $2.50, and delivery could not be expected in less than three or four days.

Sidecar arrangement which is decidedly useful for the delivery of crated motorcycles

New Ideas in Automobiling and Trucking

Hauling Freight Cars by Automobile

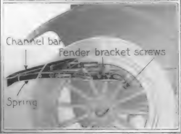
When the freight-car shortage became serious, and proper switching facilities were inadequate, a manufacturing company used an automobile to move cars to the place for unloading

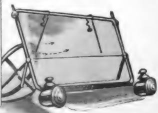
Another Ford Accessory

An instrument board attachment for a Ford car on which a speedometer is placed is shown in illustration at the left

Keeping the Windshield Clear

Below is shown a windshield wiper made of a small piece of wire covered with rubber, which is drawn across the glass horizontally





Garagemen, Please Notice

A stand for holding an automobile engine. It permits the engine being swung in any desired position with great ease

Just for the Eye

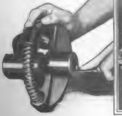
A fancy cut glass side for an automobile top. The glass is set into a frame made of metal

Safety First

An especially designed auto-guard that equips a car as if it were built-in. It consists of channel bar, springs and brackets

Doing It Gently

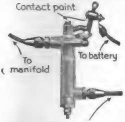
This flexible coupler for automobile transmission eliminates much of the jar usually re... n the ...ting



New Ideas in Automobiling and Trucking

Undaunted Even by Length

This automobile trailer makes it an easy matter to transport telegraph and telephone poles over streets and country roads



Good for Starting

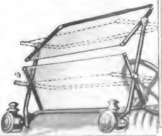
A master primer in which an electric coil is used to bring gasoline to the proper temperature for vaporizing

Saving Your Arm Muscles

A swinging arrow arm used on wind-shield to designate the course to be taken is shown at the right. Operated by driver from the steering-wheel

Many-Use Shield

The small car windshield shown below can be made ventilating, slanting or rain vision

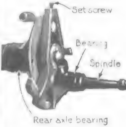


Motors for Chickens

Below is shown how Kentucky farmers haul live chickens to the market on motor trucks

Motor Comfort

A leather case with a transparent front holds the road guide book and keeps the air from turning leaves



For Fords

An auxiliary axle attachment for a car so that it can be towed home on its own wheels in case of a breakdown

Railways That Run Under Water

Visit the fishes in their homes as you travel on the Aquarium Circuit

As tunneling is costly and often very difficult, the idea of running railway cars upon the bottom of a waterway has its attractions. Air is more easily supplied to the passengers of an under-water car trip lasting, say, one hour than for submarine boats. But the bottom of water is rarely so smooth or firm that rails can be laid on it. In most cases a vast amount of grading and ballasting would have to be done before the ends of the rails could be joined. The under-water car, full of air as it is, would naturally be lighter than water and its buoyancy would cause an upward pull on the rails, which must be shaped accordingly and anchored down securely. Then, in water with ship traffic on the surface, some precautions would have to be taken to prevent ships with deep draft from cutting the submarine car from above, with disastrous results. These and other difficulties have made the counter-attractions of a good ferry seem more powerful for practical transportation purposes, and the submarine car so far finds its existence limited to amusement enterprises, where it may combine entertainment with instruction.

All that is wanted for this purpose is an airtight car which can be hauled under or partly under the water in an artificial pond by means of a cable. Through the windows the passengers can observe realistic imitations of submarine life and scenery staged in the pond. If the movements of the car are made to suggest the roughness of an ocean bed the illusion is improved.

One of the first schemes of this kind was hatched by Alexander Davidson—of Joliet, Ill., far from the ocean.

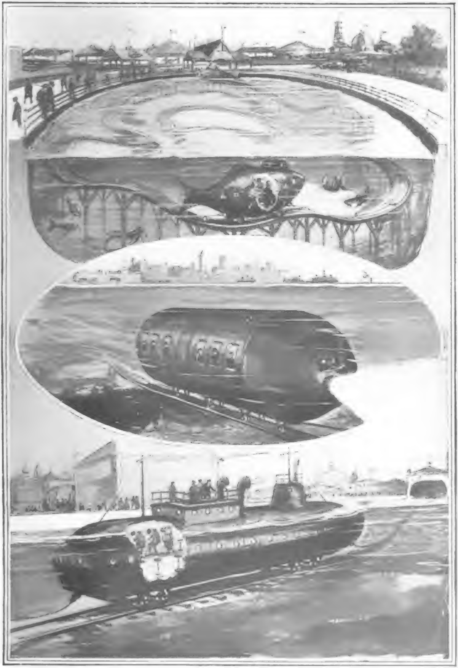
Instead of hauling his car with an endless cable, as shown in the illustration, Davidson suggests that the car could simply be allowed to run into the water by gravity and could be hauled back by a cable attached to it, as indeed would be necessary whenever, as in the case of a river or a large lake being utilized, a continuous cable is impracticable.

Charles B. Stahl of Philadelphia discovered that a little more illusion than the Davidson car provides would be desirable, and he fancied that it helps in this respect to shape the car as a submarine boat, a whale, a sea-serpent or a fish, but his main idea is to supply a track which rises and drops, so that the car will appear to dive one or more times to the bottom of the body of water. With this in view he builds his track as two parallel rails secured to a trestle of varying height, and the track rails are engaged from below as well as from above by little wheels journaled in brackets supporting the car at its sides. The claim set forth in his patent is limited entirely to this feature.

More illusion and still more illusion is the cry of the amusement resorts, and so it is found that the submarine "amusement apparatus" devised by Jacob Gunzendorfer of San Francisco responds to this demand with some new features "to simulate the actual sensations, scenes and experiences met in traveling in a submarine boat." He dispenses with the car effect in favor of the undulating and swaying motions of a boat, the track being made wavy and tipping laterally in places for this purpose. His means for holding on to the track are similar to Stahl's, and also his traction cable which pulls the car over a continuous circuit of inclosures filled with water or water marvels. But his car is never entirely submerged. The "conning tower," where the gripman is located, and some air pipes project above the water-line for the sake of safety and simplicity. As the passengers enter by a hatch which is afterwards closed above them by folding doors, they see nothing but the ceiling when looking up, and their illusion does not suffer.

The genius of Gunzendorfer comes out strongest in that he can get along with very little water. As he explains: "The trackway first passes into a tank a little distance beyond the elevated loading platform" where the start is made; "the

Underwater Railways



Three Different Inventors' Ideas of Traveling on the Ocean's Bed

The picture at the top shows Stahl's plan of a submarine car shaped like a monstrous fish and running on a "scenic railway" track. It dips and jumps in a manner suggesting the evolutions of a porpoise

Davidson's idea is a cylindrical car running on a track and hauled by a cable, while Gunzendorfer favors the illusion of a submarine of conventional form which has convenient observation portholes

tank being so constructed as to give the appearance of a lake or river." This last master trick in illusion-making is, however, not explained but hides under the easy phrase: "so constructed." He continues: "The track, however, soon emerges from the tank and the rest of the course passes through inclosures, all above the water line, the interiors of which are decorated and illuminated to produce various effects. " The first inclosure may be entitled Submarine View. "Here will be seen sharks, divers, sunken wrecks, marine growths, etc." The next inclosure is advertised as Under the Ice at the North Pole. "Here arctic views may be shown, such as seals, walrus, Eskimos." Iron balls suspended within the inclosure and in the path of the vessel (the car) produce by contact a grating or grinding sound "in imitation of icebergs striking the vessel." Such is the inventor's idea of an iceberg! The portholes through which the passengers view the wonders "are provided with convex lenses which produce the desired illusion of distance, swirling motion, etc." In other words, they blur the vision to make the passenger's imagination work more willingly. "The illumination of the different inclosures is controlled by the passage of the submarine," by electric contacts on its dummy periscope.

Altogether, there should be shocks enough in a trip like this to provide the least fertile imagination with thrills sufficient to last the average individual quite a while—and, incidentally, to make him profoundly grateful that the trouble *is* imaginary. Without that comforting knowled[illegible]yment would be dubious.

Sleep in Your Automobile and Hang Up the Baby for the Night

A RESIDENT of Tropico, California, has devised the novel automobile bed equipment shown in the accompanying illustrations. It accommodates two grown-ups and a child, adds not more than twenty pounds to the outfit and takes up no more room than an ordinary "camper's" roll of bedding.

This shows how you can arrange beds for two adults and one baby in your automobile

The back of the front seat is cut down so that it can be dropped backward, to fill the space between the front and the rear seats. This makes a bed of the interior of the car, large enough to accommodate two grown persons. The bed for the youngster consists of a hammock, which is swung above the bed. This hammock may be made of duck, about thirty inches wide by fifty-two inches long.

The Secret of the Wily Snake's Sinuous Glide

DID you ever watch a snake gliding over the ground in graceful curves and did you ever stop to think of the mechanical principles involved in its motion? The snake moves along the ground in undulating curves produced by the contraction of the longitudinal system of muscles in alternate sections of its body. That alone would not produce a forward motion, however, were it not for the friction of the scales on the underside of the snake's body against the roughnesses of the ground. By bracing the rear part of the body, the forward part is enabled to glide forward and by reversing the process the rear part is dragged forward to a new position.

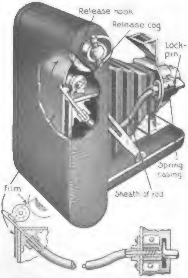
No Double Exposures with This Device

"BLESSED if I can remember," exclaimed Oscar, "whether or not I've wound the film after taking that waterfall a little while ago! I think I'll give it another turn for good luck!"

When the film roll was developed Oscar found a blank next to the negative of the waterfall and a double exposure in another part of the film.

To put an end to such uncertainty, Oscar—his full name is Oscar Howard Wilber, Jr.—has patented a very simple device which may be attached to any film camera at small cost. A flexible rod, sliding in a sheath, is so arranged, that after the trigger of the shutter of the lens has been pressed down to make an exposure, the front end of the rod is pressed forward by a spring so as to bar the trigger from returning to its former position. To remove the obstacle and make another exposure possible, the receiving roll has to be given another turn, which naturally brings an unexposed film before the lens. By turning the roll the film is drawn over another roll, provided with a disk at one end. That disk has a tooth which engages, at each revolution, the hook at the other end of the flexible rod, pulling it back and thereby releasing the trigger of the shutter for another exposure.

This clever device will spare many an amateur photographer the disappointment of losing, by double exposure, a picture valued for its happy associations with a pleasant vacation.



With a film camera equipped like this one even the most forgetful of amateur photographers cannot make a double exposure


© Western Newspaper Union
These choir boys take knitting seriously and do good work

Knitting Is Not by Any Means Confined to the Ladies

OF course Sister Susie's been sewing shirts for soldiers for some time now, and has also been knitting sweaters, socks, scarfs, etc.; consequently she has got a good start. Still, she must look to her laurels, for there is a valiant host of rivals springing up—the boys are taking a hand. In our illustration is seen a group of Cathedral choir-boys in New York, who have (ostensibly) foresworn horseplay and mischief in the intervals of waiting, and are seriously knitting comforts for the soldiers and sailor-boys. They have been properly and thoroughly instructed and are turning out just as good stuff as their sisters do. The boys display a remarkable seriousness of purpose in their new task and no longer consider knitting as mere girls' work unworthy of the attention of a manly boy.

Notch the Curb to Keep Out Automobiles

CALIFORNIA automobilists frequently mistook a motorcycle for an automobile garage and drove in with their machines. When the drivers learned their mistake they turned around and left, frequently knocking over and damaging some of the motorcycles in the garage. The owners of the garage used a very simple and effective method to keep automobiles out of their place without interfering with the passing in and out of the motorcycles. They had the inclined driveway to their garage supplanted by a curb, too high to be scaled by automobiles. For the use of the motorcycles a notch of liberal width was cut in the curb, offering a sufficiently wide and slanting runway to and from the garage. Now if a belated automobilist mistakes his goal he will be rudely awakened to the fact by a bump which will jar him in direct proportion to the force with which he hits that curb.

This notch in the curb permits motorcycles to pass, but bars automobiles very effectively

Putting Overalls on Automobiles for Protection

OWING to war conditions automobile manufacturers meet with increasing difficulty in securing box cars for shipping their automobiles to their dealers and agents. Many concerns are compelled to deliver nearly all their cars by running them overland to their destination. The cost of refinishing such cars after they have passed through rain or snow storms has become a serious question. It costs about one hundred dollars to drive one car overland from Detroit to Baltimore, as compared with thirty-four dollars by railroad. Any additional charge for refinishing the body simply adds to the cost of the car to the final purchaser.

To eliminate the charge for repolishing bodies scratched by mud, sleet, rain or snow, a Baltimore automobile dealer has invented the car overalls shown in the accompanying illustrations. Each set costs about thirty-five dollars and weighs thirty-nine pounds. It can be folded up into a parcel small enough to be put in a suitcase, to be carried back to the factory by the driver when he returns for his next car. The device consists of a padded stick across the front of the radiator, to which are attached strips of webbing which are stretched taut on each side of the car. They serve to button down pieces of rubberized top material that completely inclose the body, yet do not touch it. Strips of wood along each running board serve to hold the pieces out at the bottom and straps attached to the top serve the same purpose higher up. A separate covering fits over the radiator and front springs.

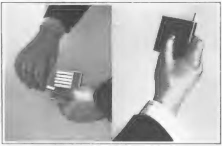
The right-hand picture shows how the padded framework and webbing are adjusted to the car, while that to the left gives an idea of the absolute protection against dirt and scratches which is afforded to the car body by its overalls.

This shows an automobile dressed in its overalls for protection against scratches

Showing the framework of sticks and webbing which holds the overalls in place

Here Is That One-Hand Cigarette Case You Want

REMEMBER that time when you were in the car, dying for a smoke, and the traffic so thick that you couldn't take your hands off the wheel for an instant? Of course you could carry your cigarettes in the packet in your vest pocket, but they are crushed and they dry out. Here is a cigarette case designed to help you in just such emergencies.



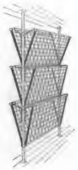
It's simple to get the cigarettes in and simpler to get them out—with one hand

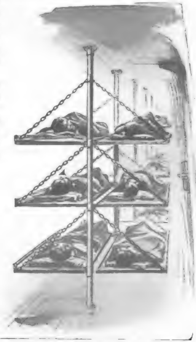
You load the case when you start out by taking off the cover. After this you merely press down the cover with the thumb and push it back again. This causes a cigarette to be protruded about an inch so that it can be drawn out with the lips. A spring then pushes another cigarette into place ready for the operation to be repeated.

The magazine of this neat little device holds ten cigarettes of average size. The case may be made plain or ornamental as individual fancy may dictate.

Use Folding Bunks to Economize Space on Trip "Over There"

OWING to the lack of ships the transports taking the American soldiers to France have to be loaded to their full capacity. In day time it is a comparatively easy matter so to distribute the men that there is no overcrowding in any part of the ship. But at night the men have to sleep, and to be able to do that they must have sufficient room to lie down. The difficulty of providing sleeping room for the men on overcrowded transports has stimulated invention. One of the simplest and best expedients adopted is shown in the accompanying illustration.





On the left the cots are folded. On the right they are shown as they appear when used as beds

Hinged to upright posts are three tiers of folding frames, the free ends of which, when in a horizontal position, are supported by chains. Each tier has two of these frames, which serve as bunks. The elastic wire netting supported by the frames forms the mattresses. When the bunks are not in use they are folded up against the posts, an arrangement by which space is greatly economized. Another advantage of these bunks is that they are easily kept clean and sanitary, and this is, of course, of the utmost importance where a large number of men are thrown together for several days in cramped quarters.

This apparatus will inform the farmer how much lime, if any, his fields require to make them productive

Every Farmer May Be His Own Soil Chemist

EVERY available acre must be made to yield to its full capacity if the United States and our allies are to win the war. Many soils fall short of their full productive capacity because they are sour or acid. This condition can be remedied by applying a sufficient amount of lime.

To overcome the difficulty of determining exactly the amount of lime necessary to neutralize the acidity of the soil a simple apparatus has been designed and placed on the market. A test requires but a few minutes. Representative samples of earth from various sections of the field are mixed to make the average soil of a field. The earth is dried, sifted and weighed in the scales which form a part of the tester, then placed in a glass bottle. A carefully measured amount of muriatic acid is poured into a smaller bottle. A definite amount of water goes into the third glass container, above which rises a marked gage. The three bottles are tightly corked and connected in series by rubber tubes.

The action of the acid upon the lime provided by nature in the soil creates a gas which passes into the tester and forces some of the water to rise in the gage. If no reaction results, it shows that no lime is present in the soil. If the water rises to the mark for three tons per acre or above it, the soil contains all the lime it needs. It should contain at least three tons in each acre and if the gage shows only two tons it means that the field requires an additional ton of lime for each acre.

The simplicity of the device makes it possible for the intelligent farmer to conduct his own experiments and apply the remedy called for, thus making it possible to keep the soil always at its highest degree of productiveness.

An imitation, in concrete, of an old Vermont well with "oaken" bucket

A Camouflaged Well-Curb

FOND memories of his childhood days on the old farm in Vermont induced R. E. Sperry, a resident of Inglewood, California, to place a replica of his father's well-curb in the garden of his California home. The curb, roof supports, roof, and even the "old oaken bucket," are made of concrete.

The well is a well in name only, obtaining its water supply from the city mains, but it serves the sentimental and picturesque purpose desired.

Holding the Screw to the Screw-Driver with a Vise-Grip

CARPENTERS, wood workers, machinists and other workers who use screw-drivers frequently have to do their work under conditions which make it impossible to use both hands at the same time in starting a screw. For many years the need was felt for some device that would hold the screw firmly against the edge of the screw-driver, that could be quickly put on and taken off and that would fit screw-drivers and screws of any size.

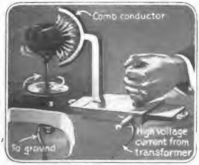
The man in the picture does not have to hold the screw. The device below does it, leaving his hands free

The screw-holder invented by David H. Royer, of Hartville, O., fulfills these requirements and is comparatively simple in construction. The mere turning of a lever closes the jaws and clamps of the device, so as to hold the screw and the screw-driver securely. By merely throwing back the lever, which works on the principle of an eccentric, the grip of the device is released so that it can be removed. To adapt the device for use with screws of different sizes, keys or wedges are used, which are inserted between the screw-holding part and the yoke, opposite the eccentric-lever clamp. Where screws are to be inserted at heights beyond convenient reach, or where lack of space interferes with the workman, this device should prove especially useful.

Electric Sparks Peel the Tomatoes. Here's How It's Done

WILLIAM H. CHAPMAN, of Portland, Me., discovered that electric sparks, if allowed to strike the skin of a tomato, will puncture it and, by expanding the air underneath the skin, loosen it from the pulp. He thinks that he has solved the tomato-peeling problem for canners.

The tomato or fruit to be treated is impaled upon a fork rotated around its long axis by a mechanically or electrically driven pulley. The fork is connected with an insulated wire which leads to the ground. A sliding base, operated by a handle, has, attached to the vertical post at its front end, a curved part lined on the inside of the curve with comb teeth of metal, through which sparks of a high voltage alternating current are allowed to pass to the impaled tomato or fruit. It is claimed that the device is very effective and does its work quickly and thoroughly. This invention will undoubtedly be of particular value to canning factories, where large quantities of tomatoes have to be peeled. For factory use, a modified form of the device is available.



The high voltage sparks puncture the tomato's skin and loosen it

The accompanying illustration conveys an idea of the workings of this device. The power may be obtained from an electric or other form of motor.

Parachute Safety Device for Airplanes

A new attempt to revive the late Sir Hiram Maxim's idea of twenty years ago

OF his first machine Sir Hiram Maxim said, over twenty years ago, that, completely stalled in the air, it would "pancake" down with the velocity of a fall of four feet. But these old machines were loaded barely more than one pound to the square foot, and their center of gravity was far below their carrying surface. The arrangement, as we know now, prevented easy flight, but it made them good parachutes. The more perfect and efficient the modern airplane became, the more it lost its former likeness to a parachute.

The wings of modern airplanes bear a load of five to seven pounds to the square foot and the center of gravity has been raised. Stalling and pancaking are nowadays considered worse than upsetting and "looping the loop"; yet pancaking, that is, descending like a parachute, is obviously the safest way to land on badly broken, mountainous ground.

Very interesting is a revival of Maxim's parachute idea in modified form, by Gerrit Van Daam, because it aims at making safe not only stalling but also landing on the worst ground. It is not feasible with heavily loaded biplanes, since in their case one wing surface blankets the other; but with lightly loaded monoplanes of the Blériot type the plan may work out satisfactorily. What such monoplanes lack in surface for a parachute-like descent, the inventor makes up, more or less, by turning the wings into true, highly-arched parachutes of increased air-resistance.

A parachute is tightly folded over the whole upper surface of each wing, being held in place by a netting. When needed, this netting is instantly loosened, and at the same time a long slot opens along the center line of each wing, admitting the air from below into the spacious pocket formed by the distending parachute, now held only by the margin of the wing.

By releasing the parachute and opening long slots in the wings through which the air rushes under the parachute, the descent of the airplane is made safe

Smoothness of the wing tops in flight is absolutely essential; so the folded parachute and the netting will have to be covered, while not in use, by a smooth light shell firmly secured to resist the air suction, yet easily removed when necessary. Of greater importance is a device that will keep the pancaking airplane on an even keel during descent. That is not so easy with a machine of the Blériot type. In that machine, the tail makes an excess of surface toward the rear, while the advanced center of gravity, balancing the equally advanced center of lift, gives an excess of weight in front. The only remedy would seem to be control independent of the machine's headway, or adjustable rudders with a circular motion of their own, which remain efficient in a stalled machine.

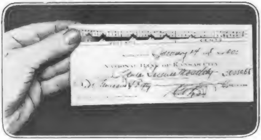
Numerous attempts have been made in the past by inventors in many countries to utilize the principle of the parachute in safety devices, but the success has not been encouraging. Parachutes have been found useful and fairly reliable for dropping from observation balloons, but have failed to give satisfaction as a safe means of escape in practically all other cases. They have not been used extensively for military purposes; but perhaps this new device may solve a hitherto baffling problem and thus add to the balance of safety in the aviator's favor.

Trench-Dwellers Cherish the Barber's Ministrations

TRY to imagine yourself in the place of a soldier who has spent two or three weeks or months in the trenches, cut off from every comfort and at all times exposed to the risk of being killed or maimed by bullet, shell or shrapnel. The excitement of the first few days gradually wears off; but the discomforts of trench-life remain and become more irksome from day to day. Little rest, little food, no chance to bathe or even wash, no opportunity to get a shave or a haircut. Such is trench-life.

Can you realize what it means to a soldier who has gone through that life for many days and weeks, when at last he is relieved and sent to the rear of the fighting line? A soldier's first thouhgt is a bath, then a shave and a haircut, clean clothes and a hot and plentiful meal. Fortunate the man who has among his treasured possessions one of those comfort kits which, in a small compass and in practical arrangement, contain all the things necessary for a man's toilet: brush, comb, scissors, razor, soap, talcum powder, etc. The picture shows one of these kits which is particularly practical because it can be carried by a strap over the shoulder. It is thus possible to get an open-air haircut or shave with all the necessary adjuncts, though some of the comforts of the city barber shop may be lacking. But the soldier will scarcely mind this.

Trench barbering is frequently an outdoor operation. Our pictures show procedure and comfort-kit containing all the implements of the barber's trade



Check-raisers take notice. The amount to be paid is cut out of a double row of figures

Making Things Harder for the Forger of Checks

AN unusually clever device for protecting checks from being raised by forgery has been invented by C. W. Elrod, of Lincoln, Neb. The accompanying il'ustration clearly demonstrates the idea and its application. At the top of the check is a double row of figures indexing dollars, another double row indexing cents. The figures representing the amount of the check are cut out of that double row of index figures in such a manner that they appear on the little triangular tabs which in cutting were left attached to the check. The control-strip, detached from the check and forming part of the stub of the check, shows, cut out of the first row of figures, the figures representing the amount of the check, which may be identified by the corresponding figures in the second row. The inventor proposes to have the paper of the checks watermarked with the words: "Only good for amount shown on margin," as an additional protection against such forgery.

Those who have been victimized by bank swindlers will be glad of this ingenious means of protecting themselves hereafter.

Jeff Tesreau, the star pitcher of the Giants, about to baffle the batter with his great spitball

Spitball Myths

Why pitched baseballs curve and why the spitballs are scientifically foolish

By P. A. Vaile

[Author of "Swerve, or the Flight of the Ball," "Modern Golf," "Modern Tennis"]

NO definite explanation of the vagaries of the spitball or the "shine" ball has ever, so far as I am aware, been given. I have seen many generalizations, but no specific explanation, and so I am now essaying the task in the hope that it may prove interesting, and possibly serviceable, to players of baseball.

Definite and consistent curves in baseball, or swerves, as they are called in cricket, can be produced only by spin imparted to the ball by all the fingers and thumb or some of them.

Comparatively few people know that the "top" of a wheel moves more quickly through the atmosphere than the "bottom"; yet this is undoubtedly so. The reason is that at the "top" of the wheel the motions of revolution and progression "conspire" or coincide. To put it, perhaps, a little more simply we may say that the wheel is going forward and is rolling forwardly, therefore at the top we have the sum of these two motions.

The Spitball

Spin *A* to *B*. Flight *D* to *E*. Therefore spin and progression conspire at portion shaded dark, *C*. At portion *F*, the spin is against the progression. Consequently, the ball is forced towards *F'*, as there is less friction there than at *C*

It is otherwise at the bottom of the wheel. Here, as this portion of the wheel is revolving backwardly, the rotary motion conflicts with the progressive motion, and instead of the sum of two motions, we get the difference. Of course all portions of the wheel viewed as a whole are progressing towards its destination at the same rate. It is merely that certain constantly-changing portions are moving through the atmosphere at different speeds.

That, shortly, is the whole secret of curve or swerve, for the side of the ball whereon the motions conspire sets up more friction with the air than that on which they conflict. A projectile always seeks the line of least resistance, therefore the ball is forced over toward the side where the spin is backward.

I may here repeat that there is, so far as I am aware, absolutely no other means whereby definite and consistent curves with a ball can be obtained. If there be, and anyone can tell us of them, the scientific world will be much interested.

This brings us to a consideration of the spitball and the "shine" ball. Any curve that these balls have is not due to the action of the air on the wet or shiny patch on the ball.

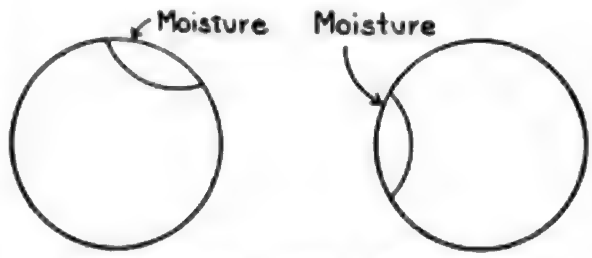
It is due to the amount of spin that is imparted to them by the pitcher on account of those patches. What finally decides the nature of the spin on any ball must necessarily be the last point of contact between the ball and the player. If a ball is held, say, mainly by two fingers and a thumb, and pitched from that hold, the flesh grip of the three engaging members may be approximately the same, except for the force of gravity's bearing the ball down on the lowest of the three, and the push of any downward action in the throw.

Now, suppose that the portion of the ball remote, or farthest away from the lowest engaging member, naturally, in

most cases, the thumb, is touched or held on a spot that is covered with moisture or has been made smooth and shiny with some substance. It stands to reason that the ball will slide away here with less friction than where it is held with a natural flesh-grip. It follows therefore that this artificial release must have considerable influence in determining the amount of spin imparted to the ball, and it would seem a reasonable deduction that the amount of spin and consequently of curve must vary considerably to correspond with the degree of slipperiness of the patch on the ball and whether it was on top of the ball or on the bottom.

The "shine" ball and the spitball

At left: "Shine" ball leaving pitcher's hands. At right: "Shine" ball going over plate. The least resistant portion, the shiny patch, has gone to the front



At left: Spitball leaving pitcher's hands. At right: Spitball going over plate. Moisture having gripped the atmosphere, that portion goes behind the ball during its flight, which it does not do in practical baseball

If anyone thinks that the curve or swerve in these balls is obtained from the effect of the shine or the spit, apart from the action of the spin, he may speedily disabuse his mind of the idea by putting a number of "shine" or spitballs in a driving machine, such as those used by golf-ball makers, and propelling them violently.

© Int. Film Serv.

Russell, of the White Sox, just after delivering a powerful "spitter"

If, as is quite conceivable, the patches had any effect, it would not be consistent and persistent, for, if the wet retarded one side of the ball enough to be appreciable, the wet patch would speedily go behind the ball and stay there, or swing across and show on the other side, when it would produce a return swerve!

Then baseballers would in that case have a new ball, the zig-zag!

The effect, if any, on a similarly-propelled "shine" ball would probably be opposed to that of the spitball.

The erratic flight of these balls, and, comparatively speaking, the lack of control over them that the pitcher has, lend color to the idea that their production is, as I have indicated, largely adventitious.

Many prominent players think that any attempt artificially to alter the natural flesh-grip should be stopped by law. This must always be difficult; but if pitchers would only understand that, to a very great extent, the spitball and the "shine" ball are myths, they would do much better with a natural delivery, backed by a little more practical knowledge as to what it really is that they are trying to do; and batters would lose a bogey.

Nerve Shock Due to Detonations Less Wearing Than War Strain

THE term shell shock has misled many persons to believe that it is due to the profound impression or shock produced on the nervous system by the detonations of high explosives. No doubt, there are cases of actual brain or nerve injury due to concussion of the air accompanying shell explosions, but these mechanical causes are a great deal less frequently responsible for war neuroses than the mental effects of general war strain. It is remarkable that these war neuroses, common as they are among privates and officers alike, are seldom found in men who have been actually wounded. Perhaps this seeming anomaly is due to the actual wound shock offsetting the mental impression affecting the controlling nerve-center in such cases.

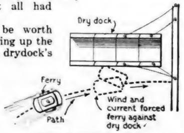
A passenger ferryboat rammed this mammoth floating drydock in a dense fog. The damaged section promptly separated from the others, turned sidewise and floated inside its former companions

Nothing Troubles This Drydock. It Can Repair Even Itself

THE big floating drydock in the harbor of Tacoma, Washington, was rammed in a dense fog by a passenger ferryboat, and one of its four sections driven in. The ferryboat was of the old-fashioned river type with a draft of only three feet. In the winds and currents of Tacoma's open harbor it was notoriously unmanageable.

But the drydock was a match for the ferryboat. The section which the ferryboat had damaged was promptly separated from the others, turned sidewise, and floated *inside* its former companions. Men thereupon went to work with a will and elevated the damaged brother above the water's surface so that repairs could be made. And by this time all four sections are back in the water again, joined together, and doing each day their daily work as if nothing at all had happened.

Incidentally it may be worth while to note that doctoring up the damaged section was the drydock's job, and it accord- [illegible] started a life of [illegible]ing by first re- [illegible] itself. [illegible] the illustration [illegible] the entire dry- [illegible] is shown at the [illegible] at the right [illegible] section is [illegible] the two submerged sections [illegible] self, undergoing repairs. [illegible] below shows how collision [illegible] and ferryboat occurred.



How ferryboat hit the dock that repaired itself

Does a Locomotive Wheel Travel Slower or Faster than the Train?

IT is an interesting point to consider that on a locomotive wheel, the circumference is continually traveling at different speeds. First a point on the circumference of the wheel will go faster than the rest of the locomotive; then that same point will go slower; at still other times, the point will travel at a speed equal to that of the locomotive cabin.

This paradox is explained by considering first the point on the circumference farthest to the rear of the wheel's center. When the center of the wheel moves forward with the same speed as the rest of the locomotive, that point will move around and in a short time it will get ahead of the center. Obviously, to do this, this point has to travel faster than the locomotive.

As the train moves on from this position, however, the average speed of that same point will become less than that of the locomotive. This is evident, since the point will soon change from a position directly in front of the wheel's center to another point directly in the rear.

This apparent paradox is not related to the old saw concerning the relative speeds of a kangaroo's hind legs and front legs when jumping Australian sand hills.

What Makes the Rumble of Thunder?

WHY does thunder rumble? The path of a lightning flash through the air may be several miles in length. All along this path the sudden expansion of the heated air—a true explosion—sets up an atmospheric wave, which spreads in all directions, and eventually registers upon our ears as thunder. Since the lightning discharge is almost instantaneous, the sound wave is produced at very nearly the same time along the whole path. But the sound wave travels slowly through the air. Its speed is approximately 1,090 feet per second. Thus the sound from the part of the lightning's path that is nearest to us reaches us first, and that from other parts of the path afterward, according to their distance. Intermittent crashes and booming effects are due chiefly to irregularities in the shape of the path.

Making Window-Cleaning Safe

FOR the benefit of window cleaners and painters, Paul Wolff, a Hungarian in Pittsburgh, Pa., has invented a window chair or scaffold, which rests upon the window sill, extending outward and providing the workman with a secure support. The device is so arranged that it can quickly be clamped to the window frame and just as readily removed. The window frame is firmly held between a rubber-covered hook or brace and the movable clamp, which is operated by a screw, like the movable jaw of a vise.

Chair clamped to window frame with the movable jaw of a vise

© Kadel & Herbert

This huge bat-like kite is the plaything of a Japanese prince. His place in the world requires distinctive size even in his toys

Giant Kite for the Crown Prince of Sunny Japan

WHILE the Crown Prince of Japan was on his winter vacation at the palace of Numazu he had the huge kite, which is the subject of our illustration, made for his amusement. This monster is in the form of a bird and it measures twenty-four feet from wing-tip to wing-tip. It is capable of attaining great heights and its pull is so powerful that it can lift a man off his feet; consequently, special winding machinery is needed to control it.

What American boy would like to swap places with the heir to the Cherry-blossom Empire's throne? Step lively, boys — the line forms on the right!

Half Million Words in English Use

THE English vocabulary has grown to great size, according to Professor Clark S. Northup, of Cornell University. "The number of words found in old English literature does not exceed thirty thousand; recent dictionaries have listed more than four hundred thousand."

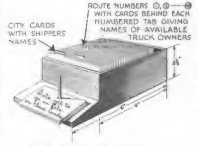
Solving the Railroad Problem

Connecticut does it by making the return trip profitable for motor trucks

LAST autumn, when the railroad congestion became acute, the State of Connecticut, which is the heart of the small arms and ammunition industry of the United States, found itself in a desperate situation. Ammunition partly finished in one plant must be hauled to other plants for different machining operations before it is completed. As there were no freight cars at all, or too few, the war material could not be moved by the railroads. Many manufacturers had to use motor trucks for that purpose, and, in some cases, even to get raw materials for their plants and to deliver finished goods to New York for shipment abroad.

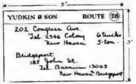
The first problem was to keep the roads open. This was accomplished by taking the work of removing the snow out of the hands of the townships and turning it over to the State. The second problem was to make the haulage as economical as possible by providing return loads for the trucks.

To make sure of return loads, the State, under the direction of W. S. Conning, chairman of the Motor Truck Transportation Committee of the State Council of Defense, formed Return Loads Bureaus in fourteen of the important cities of the State. Each bureau keeps a file of all the trucks available for overland haulage work. The bureau supplies information regarding trucking companies and their routes to shippers and keeps a record of all applications. This enables the bureau to post the truckmen on the prospects of obtaining a return load to their home city after they have delivered their outgoing load.



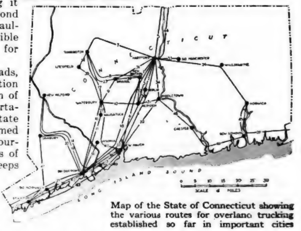
A file like this is kept in every one of the Return Loads bureaus in fourteen cities of Connecticut

The telephones of the bureaus are listed under the heading "Return Loads" to facilitate telephoning. The routes covered are numbered, and the trucks running on each route are given corresponding index numbers in the file. There are already more than seven hundred motor trucks listed under this plan and each bureau has a complete file of all available vehicles and a map of the routes covered.



One of the City cards bearing the name of a trucking concern listed in the files of the bureau

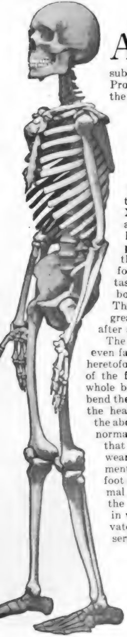
Since it costs almost as much to run a truck empty as it does loaded, it will easily be seen how advantageous it is to both shipper and truckman to be sure of a return load.

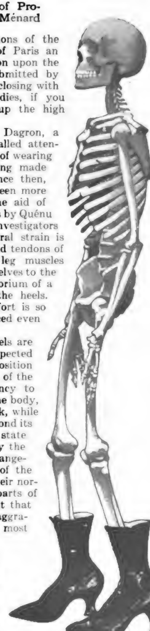


Map of the State of Connecticut showing the various routes for overland trucking established so far in important cities

Beware of the Perils of the High Heel

Listen to the warnings of Professor Quénu and Doctor Ménard





At one of the recent sessions of the Academy of Medicine of Paris an interesting communication upon the subject of high heels was submitted by Prof. Quénu and Dr. Ménard, closing with the ominous warning: "Ladies, if you value your health, give up the high heels of your shoes!"

Several years ago Dr. Dagron, a noted French physician, called attention to the injurious effects of wearing high heels, but his warning made but little impression. Since then, however, the subject has been more thoroughly studied with the aid of X-Rays and moving pictures by Quénu and Ménard. These two investigators have found that an unnatural strain is placed upon the muscles and tendons of the foot, as well as upon leg muscles forced to accommodate themselves to the task of maintaining the equilibrium of a body unnaturally raised by the heels. The strain caused by this effort is so great that fatigue is experienced even after a short walk.

The effects of wearing high heels are even farther reaching than was suspected heretofore. The change of the position of the foot disturbs the equilibrium of the whole body. As there is a tendency to bend the knees the upper part of the body, the head and chest, is thrown back, while the abdomen is forced forward beyond its normal position. The physicians state that the disturbances caused by the wearing of high heels, the disarrangement of the articulated bones of the foot and the throwing out of their normal position of the different parts of the body are serious enough, but that in walking these effects are so aggravated, that they produce the most serious internal disorders.

The skeleton on the left shows the graceful poise of the normally supported body

The skeleton on the right shows how high heels change normal position of the bones

The "Little Church of the Flowers" and How It Got Its Name

THE latest thing in churches is to be found in a southern California town, in the way of growing plants.

Two rows of seats and a center aisle comprise the middle of the building. On each side beyond these seats are beautiful arches, from which large fern baskets are suspended, and beyond these arches, on both sides of the building, is a sloping roof of sky lights.

Growing plants and flowers give a peculiar charm to this little church in a southern California town

A cement walk extends between two rows of ferns, shrubs and flowering plants. In the columns are little pockets where choice begonias bloom. A similar church will be built in Los Angeles.

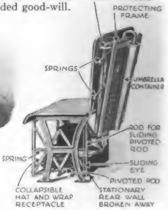
This Device Will Take Care of Your Street Clothes at the Theater

DID you ever, dear reader, have the misfortune to reserve seats at the theater and not arrive there until after the performance had started? Do you remember taking your coat off in the lobby and carrying it on your arm down to your seat? And then the wild scramble past all the other people in the row, with the resulting frenzied grabbing of hats and coats and wraps so that you would not accumulate them in your career as a snowball grows as it rolls down a hill? Do you remember the scowls and the bitten-off hasty [illegible]ions that you left in your destructive wake? If this harrowing experience has ever been yours you are going to give the inventor of a new little wardrobe your heartiest and most unqualified support. Here it is:

To accommodate the hat there is a sliding rack under the seat which extends and folds up on the lazy tongs principle. For the coat there is a hanger attached to the back of the seat and the coat is protected by a light framework, to which, in turn, is attached a long cylindrical receptacle for the cane or umbrella. The whole forms a remarkably compact and complete wardrobe that will accommodate all one's street clothes without the bother and inconvenience of the checkroom, with its crush and scramble and long line of waiting patrons, and, last but not least, there is no tip.

Owners of theaters might find it good policy to introduce this device in their houses, partly as an advertising novelty and partly as something contributing to the comfort of their patrons. It will, no doubt, pay in added good-will.

Imagine yourself in that man's place and you will sympathize with him



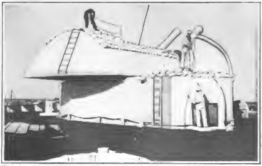
Like a modern trunk this device will hold your hat, overcoat and umbrella

A New Use for the Little Tractor: Spotting Freight Cars for Large Plants

A SMALL industrial "creeper" tractor can "spot" a carload of coal having a total weight of 45,000 pounds. The illustration proves it. One of these tractors has taken the place of a switch-engine or a gang of workmen with pinch bars for spotting or switching cars at a large industrial plant in Ohio. As the engine is railroad property, it is available only for a comparatively short time each day, while the tractor, which is always on the premises, can be utilized at all times.

The tractor does not travel on wheels, but lays its own track, and consequently can pass over obstacles and move material from one department to another without marring the surface over which it travels. The over-all width of the tractor is fifty inches and it is but two inches more in height, so that it can pass through ordinary sized factory doors easily. The tractor is used for bringing material from the factory to the shipping room or to cars that are to be loaded and for the unloading of incoming shipments, and it also transports material between the various buildings of the plant.


This little caterpillar tractor can pull without trouble a loaded car weighing 45,000 pounds, and do it easily


© Underwood and Underwood

The protective power of the armorplate of the turret is greatly enhanced by a layer of sandbags as shown

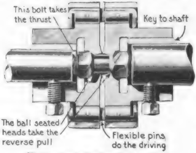
Sandbags Used as Protective Covering Even on War Ships

THE use of sandbags or wicker baskets filled with sand as a protection against hostile projectiles in warfare is by no means new, but the present war has probably seen the most extensive use ever known of this means of defence. Against the enormous force of the modern explosives neither steel nor concrete offers adequate protection. It was found that earth or sand, either in a loose state or in bags, formed a more efficient protection against shells, shrapnel or the projectiles of small arms or machine guns than barricades of other material.

The accompanying picture taken on board of a British monitor preparing to go into action shows that sandbags as a means of protection are by no means confined to the warfare in the trenches. A covering of sandbags is placed on the roof of the turret to give additional protection to the big guns and the gun crew, should they come within range of a hostile battleship, or be attacked by a hostile airplane. Without these sandbags the roof of the turret would offer little protection against missiles dropping upon them almost vertically. This applies to projectiles fired from guns with a high angle of elevation and to bombs dropped from aircraft.

Flexible Coupling Takes Side Strain Off Shafting

UNLESS there is perfect alinement of the propeller shaft with the engine or reverse-gear shaft there is sure to be trouble in any engine-propelled marine craft. Binding bearings, with resulting friction, hot journals and loss of power, or excessive vibration and consequent wear are the natural results of the side strain caused by the imperfect alinement. As a truly perfect alinement is possible only in theory, some provision must be made to compensate for defects in the alinement which may develop from various causes at any time. It was found that a flexible coupling for connecting the propeller shaft with the engine constituted the best remedy. One of these flexible couplings, which has been successfully tried for marine engines of various types, is here shown in cross section.



The center bolt gives the required rigidity to the coupling, the laminated steel pins of the flange give it the necessary flexibility

The coupling consists of two cast-iron or steel flanges connected by flexible laminated steel pins instead of rigid bolts. The construction of the coupling is made plain by the diagram. The center bolt takes the push or pull, as the case may be, from one shaft to the other. The flexible laminated steel pins, which connect the two flanges, allow sufficient play to give the coupling universal action within its intended limits. The pins take no push or pull, their business is to drive. It is expected that this arrangement will eliminate much trouble rto encountered.

A First Aid to the Singing-Teacher. It Analyzes the Voice

EVERY tone of the human voice is composed of fundamentals and overtones, according to the musical authorities. It is the presence or absence of the overtones which decides whether a tone is musical or otherwise. Hence overtones constitute the essentials of the singing voice.

Professor Howard H. Hanson, of San José, Calif., has perfected a device which determines what overtones of a particular voice need cultivating or subduing for the sake of bringing the voice up to its maximum beauty. The device is constructed principally of tin and resembles a huge stove-pipe joint from which tubes of various lengths and sizes protrude horizontally.

There are sixteen of the tubes, and each is tuned to a different overtone of middle "C." When a voice is to be tested, the student sings the five vowels on middle "C" into the protruding end of a tube. The sound waves of the tone enter a resonating chamber where the presence or absence of the desired overtone is recorded. The test is repeated through each of the sixteen tubes and the records thus obtained clearly show the teacher on which vowel sounds most work is required.

The student sings into the tubes to test quality of voice

Each of the tubes registers a certain overtone of middle "C"

Canned Ostrich Eggs May Find a Market in London

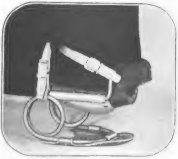
SIGNS reading "Newly canned ostrich eggs for sale" may soon meet the eyes of the housewife looking into the windows of grocery stores in London. This statement is based on the fact that ostrich eggs are being packed experimentally in South America for shipment to England in liquid form. One ostrich egg is equal to about two dozen hen's eggs. If the canning of these eggs proves successful, it will mean the salvation of the ostrich growing industry which has suffered considerably as a result of the war. It will take a large family to consume one breakfast egg.

Delightfully refreshing is a swim taken on this aquatic bicycle which has air chambers for buoying you up, a propeller for forward progress, and a rudder for turning

Kneeling in Cotton Fields Made Comfortable by This Pad

COTTON pickers have to work for hours at a time kneeling upon the damp ground. They suffer tortures. To relieve them, Robert T. Jenney and Rudolph J. Langer of Monticello, Ia., invented a knee-protector. After the invention was perfected, it became apparent that it would be equally beneficial to miners, cement workers, carpenters and gardeners.

The knee-protector is made of strong spring steel. It is just of the right height to place the foot in a restful position. The knee rests in a felt-padded hammock of leather or canvas between the upper arms of the coiled spring while to the lower arms a metal shoe is fastened which is slightly curved upwards in front. The device is fastened to the leg by two straps, one above and the other below the knee. The construction of this humanitarian device is shown in the accompanying illustration. It should prove beneficial to many workers.



The knee rests in a padded hammock of leather or canvas supported by coiled springs

Ride This New Underwater Bicycle —It's Great Sport at the Beach

AT the average bathing beach about all you can do is swim, or paddle around in an old canoe.

And so P. Kraemer of Jersey City, N. J., devised the underwater bicycle here illustrated. With this bicycle you can make as much as six or eight miles per hour, which is fast for swimming.

But do you swim on a bicycle? You do on Kraemer's, in a sense, for most of your body is submerged. The submerged feature was especially desired by the inventor. He wants you to get the full effect of the water's coolness on a hot day.

The two tanks shown are of course filled with air, so as to support a rider of almost any weight. The handlebars control the rudder.

This contrivance should appeal to those for whom ordinary swimming methods are too slow. This aquatic bicycle may make the fish join the birds in wondering where man's encroachments on other domains are to end.

Home-Training for Wireless Heroes

A phonograph and book of rules will help to qualify you for a radio operator's post

THE wireless operator of the future who may, during the din of battle, receive a message that will result in victory for his country, or, from the deck of a ship, pick up an appeal that will save hundreds of lives, can prepare himself for such heroic acts by sitting in his home and listening to the records of a phonograph. And if he's a faithful student, he may be able to prepare himself for these pulse-stirring rôles in from three to four months.

At the beginning of the course the student merely listens to the dots and dashes as they issue from the machine and compares them with letters and figures in a booklet. In the first record each letter and figure is first announced orally and then signalled three times. In the second lesson he is initiated into the difficulties of punctuation and special signs, while the next step finds him struggling with sentences like this: "The quick brown fox jumped right over the lazy dog." And from this reminder of his early school days the prospective operator is called on to translate the dots and dashes of a "press" dispatch — sent just as it would come from the key of a veteran radio man at Arlington or Poldhu. Static, interference from other stations and the reception of code words are taken up in other rec[illegible]

An ordinary telegraph key was used in making the records. After the student has become familiar enough with the letters to recognize them as he hears the dots and dashes, he is advised to manipulate the phonograph so that they will reach his ears in irregular sequence, in order that his skill in receiving may be tested.

The phonograph is employed for instruction in sending as well as receiving. As soon as the prospective operator has become able instantly to translate the letters as they are produced by the phonograph, he is ready to begin practice with the telegraph key. The booklet accompanying the machine gives him information regarding the position of the hand and calls attention to common faults in transmitting. Simultaneous operation of the key and listening to records will develop evenness, accuracy and speed.

Thus the student learns the preliminary essentials of how to become a wireless operator. What use he will make of the instruction will be shown when he is placed in emergencies in which men of the radio key frequently find themselves. In the course of time his ear will become as familiar with the dots and dashes of the language of the air as with ordinary speech, and his fingers will manipulate the keys almost mechanically.

The upper picture shows the correct way of working the key. In the lower picture the student practices sending while listening to a message from phonograph

Looking Through Your Hand

An optical illusion and at the same time a valuable test

IN a recent issue of "La Nature" H. Volta speaks interestingly of an instrument which he calls "The illusion of the hole through the hand" and incidentally points out the value of that experiment as a clinical test for cross-eyes and other defects of vision.

Place before one eye, the right one, for instance, a roll of paper or a pasteboard tube; then hold the left hand, open, to the left of the tube, at a distance of about ten inches from the left eye. The right eye sees what is framed in by the tube; the left eye sees the hand. In the brain the images of the two eyes are fused together; it seems as if the left hand were perforated by a hole through which can be seen the objects included in the field of the tube. What is the explanation of this curious phenomenon?

With normal vision a person trying this experiment should see an apparent opening in the middle of the hand, as shown in the picture on the left

When we look at an object, each eye sees it, but the impressions of the retinas are transmitted in such a way as to register but a single image in the brain. That is what the physicians express by saying that the rays emanating from the same object strike identical points of our retinas; the optical nerves leading from these points are combined so as to connect with a single brain cell. If some trouble affects one of the eyes, the points of the two retinas which have received impressions are no longer symmetrical; the two images cannot be fused into a single brain perception; we see double, a condition which is known scientifically as diplopia.

The explanation is quite simple, but, and this is the interesting feature of this experiment, one may deduct from it the most interesting clinical indications, which make it possible to combat from the start the cross-eyedness with which children are troubled so frequently and which parents too often have a tendency to neglect.

Cross-eyedness develops in children gradually—so gradually, in fact, that the eyes become accustomed to the defect and do not betray its existence by seeing double. The functions of the eye with the less perfect vision are simply neutralized. When the good eye is closed, the poor eye sees; but when the good eye is opened again the images conveyed by the poor eye are again disregarded by the brain. Although there is no double vision, binocular vision is no longer possible.

By means of the experiment described it is possible to ascertain whether correct binocular vision is possible to the person tested. With normal vision the apparent hole should be seen in the middle of the hand. If the hand or the view in the field of the tube is not seen, one of the eyes does not see at all, or its impressions are neutralized. If cross-eyedness exists, the hole will appear to the right or the left, above or below the hand. The distance at which the left hand has to be held from the end of the tube before the hole most nearly approaches its center differs according to the degree of cross-eyedness, and will furnish the eye specialist valuable information.

Photographing Holland in California

New motion picture trickery, how it is done and how pleasing the results

WHEN the legitimate stage wishes to produce a scene laid in some foreign country all it relies on is a few painted sets and appropriate furniture. In motion pictures, however, the director has to find some means of building a real duplicate.

An excellent illustration of the resourcefulness displayed in such matters is found in the construction by a film director of a Dutch village—in California! The buildings were simple enough; a rigid framework covered with *papier maché*, light plaster or even painted burlap being quite sufficient. But the canals and bridges were by no means so simply constructed. Fortunately, however, the scenario did not call for any dives or marine disasters. Hence the canal was only a foot deep—just enough to float a small boat. The sides were constructed of wood, well tarred and caulked, and the earth in the stream bed tamped solid to prevent drainage. Then began the real camouflaging.

It would never do, of course, for you to suspect that the scene was made in the studio loft, in spite of the fact that common sense would tell you that it couldn't have been made anywhere else. So the framework, as it were, had to be covered over and retouched until every detail was perfect. One of our photographs shows the result. The "bricks" on the sidewalk are thin strips of wood with loose sand sprinkled between. The tree was cut in a nearby field the day before this photograph was taken. The bridge, apparently of concrete, is simply wood covered with plaster. The flag paving on the bridge itself is merely wood grooved in irregular oblongs and squares

This picture shows how a motion picture concern built a Dutch village, canal, bridge, and houses in California. The framework is rigid, the rest mainly papier maché

It is hard to realize that this remarkably life-like Dutch village scene is all sham and deceiving trickery, built to serve only a brief while until the camera has caught it

to assume the appearance of paving stones. The roofs of the houses are made of tiling and shingles laid on loosely and easily removed. For next week this village may be in Siberia, with a roof of ice, and the canal will be the road before the dismal village inn!

What the Twenty-Dollar Gold Piece Has Been Through

THE twenty-dollar gold piece has had an interesting career. Jewelers melted it for their fine gold work, some forty years ago, and were very successful until the Government experts discovered the practice and stopped it in short order by "peppering" the gold with iridium. Following this, unscrupulous persons attempted to gather scrap gold by "sweating," or placing a number of coins in a bag and then shaking them violently, thus obtaining tiny particles of gold by friction. After these coins had been put through the "sweating" process it was an easy matter to pass them on unsuspecting tradesmen and banks, provided, of course, that the victims did not weigh the coin. The amount of gold scrap obtained by the "sweating" process was so small that the bags had to be burned to recover it.

Another way was to "strip" a coin by putting it into an electro-chemical bath, getting thereby a slight residue of gold on a copper plate, which was afterward melted and the metals separated. Because this method discolored the gold it was not very popular. One of the most successful schemes, however, was the use of a specially prepared male and female die. The diameter of the die was about one one-thousandth of an inch smaller than the diameter of the coin. It was so made that after the resultant rim of metal was cut off the milled edges remained. From a single $20 coin the gold thus obtained was worth about fifty cents, and the coin, to all appearances, had not been tampered with.

Turning a Bicycle Into a Railway Hand Car

"FLAG train No. 71, southbound, before it crosses the creek and make it back into siding to let southbound Special pass." Such was the order conveyed by the ticker in the little wayside station.

"By George," exclaims the station agent, "this is an ugly fix! The creek is five miles from here and No. 71 is due here in half an hour."

"Look here, Jim," interrupts his friend Harry; "Tony is sick and will lend me that outfit of his. I can hit it up some and make the trip easily!"

A few turns of the hand turned this bicycle into a speedy railway hand car

Jim eagerly approves of the plan. Tony consented to the loan and Harry "hit it up" so thoroughly, that he reached the creek long before No. 71 came in sight. The danger of a collision was averted.

Tony's "outfit" was merely a bicycle equipped with an attachment invented by Agostino Rea, of Helper, Utah, which makes it possible to run the bicycle on railroad tracks. The device is simple of construction and inexpensive. Attached to the axles of the wheels of the bicycle are forked arms provided with grooved trolley wheels at their free ends. These forks can be swung down so that the trolley wheels engage the rail and prevent the wheels of the bicycle from leaving the track. A long arm, with a roller at the free end, is attached to the frame of the bicycle. When in use, the roller runs on the other rail of the track and acts as a brace to maintain the balance of the wheel. When not needed, the arms with the trolley wheels and the balancing arm may be swung out of the way and fastened.

Making a Wind-Proof, Rain-Proof Chicken House from Piano Boxes

WHEN the United States Department of Agriculture is urging that every back-yard be the home for a flock of chickens, an inexpensive and novel plan of converting two piano boxes into a poultry house becomes at once practical and advisable.

The two boxes are placed back to back, three feet apart, the back and top of each removed, a frame for roof and floor added, and the part between the boxes built in with boards removed from the two boxes. The house is covered with roofing paper which will keep out wind and rain. The piano boxes can be purchased for $2.50 each. The complete home for the poultry can be built quickly and easily for $12. It will comfortably house a dozen hens.

The rear window provides ventilation and insures coolness in warm weather. Windows can be used instead of solid shutters so that the houses will be lighter when closed.

A door can be cut at the end, covered with muslin to insure good ventilation.

To insure dryness the boxes should rest on brick supports and be surrounded by drainage gutters

The submerged dry dock was placed under the stern of the cruiser and then pumped out, thereby lifting the stern out of the water. This remarkable feat took place at Honolulu

A Four-Hundred-Foot Ship in a Three-Hundred-Foot Dock

THE unusual feat of dry-docking a ship of four hundred and forty-six feet in length and a displacement of 9,300 tons in a dry dock only three hundred feet long and with a lifting capacity of 4,500 tons, was accomplished a short time ago, when the Japanese first-class cruiser *Azuma*, the propeller of which had been damaged, was docked for repairs in a floating dry dock at Honolulu. In order to carry out this undertaking, the dock was submerged and placed under the stern of the cruiser and then pumped out. It is said to have been the first time that this seemingly impossible feat was attempted. The result was extremely gratifying, and the remarkable procedure is sure to find imitators elsewhere.

Thirty Million Collisions in a Day—the Earth's Record

ASTRONOMERS have collected a great deal of material in recent years which seems to prove that there is an enormous mass of non-luminous comet or meteorite material scattered through stellar space. It is estimated that as many as twenty or thirty millions of such bodies collide with the earth every twenty-four hours. Assuming a fairly even distribution of these cosmic particles in space, their quantity and number must be beyond computation. Clouds of such particles are now believed to be the cause of the dark and starless areas in regions where bright stars are numerous. It is assumed that clouds of meteorite material prevent us from seeing the stars beyond in these particular regions of space. The dark spaces in the Milky Way, the so-called "coal sacks" in the constellation of Sagittarius and many other starless regions are accounted for in this manner.

Photographic star records made at Harvard and elsewhere during recent years have supplied much valuable information to support the theory that the so-called new stars, also known as temporary stars, which flash out at points where previously no stars were known to exist, are stars which suddenly become luminous by passing through a cloud of meteoric particles. While passing through the cloud the faintly luminous star is in effect bombarded at high velocity by the meteoric cloud. The surface strata become heated and the luminosity of the star increases rapidly.

How the French Developed Their Newest Type of Battleplane

FOR a long time the principal French reconnoitering and bombing airplanes were only slight modifications of the early Henry Farman type, well known in America. That airplane was stripped down to the last essentials: ailerons, elevator, rudder and a simple four-wheeled landing gear with rubber shock-absorbers (then a novelty). The pilot was perched on the front edge of the lower plane. A large fuel tank formed the back of his seat; directly behind it was the Gnome motor with a big, low-pitched pusher-propeller. That arrangement made a fuselage or hull impracticable. The big, double-control surfaces had to be carried by a wide open "cage" of poles (at first of bamboo) and wires. Farman was not a scientist, not an engineer, not an inventor, but a bicycle rider who knew what was practical in flying.

When the war began, Farman's homely type of airplane ousted the complicated Breguet biplanes and all the monoplanes because of its dependability. It was not improved much—simply given stronger, better engines, simpler control surfaces, some streamlining and an enclosed body for the aviator. All this was, of course, not sufficient to permit the development of modern speeds.

From the very beginning the French also had some Caudrons, large biplanes, from which the modern type of speed airplanes was developed. In these machines the body was turned into a fuselage because there were twin motors and propellers out on the planes. A central fuselage offered, therefore, the simplest mounting for rudder, elevator and stabilizers. This developed in it the germ of a speed machine. Thus it came about that the Caudron forged ahead more and more, as the science of aviation progressed and developed.

The accompanying illustration shows one of the latest developments of this type, a true, up-to-date speed machine. Streamlining is proclaimed paramount by the form of the engine housings which are so arranged that they permit the wind to reach and cool the machinery. Other obvious proofs of minimum head resistance are the characteristic nose of the fuselage, the remarkably slender struts and staywires made vibrationless by holding two parallel wires against an intermediate piece of wood.

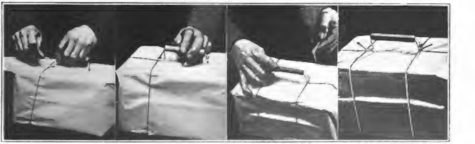
Appropriately Enough — A Band of Brigands Were the First "Chauffeurs"

HERE is a justification for a bit of our American slang. It seems that the word chauffeur means "scorcher."

Over a century ago, some particularly brigandish brigands lived on the borderland between France and Germany. To force ransoms from their captives, these desperadoes grilled the soles of their victims' feet before a fierce fire. So the countryfolk referred to the band as scorchers or, in French, *chauffeurs*.

Not so many years back, when these same imaginative French were in need of a descriptive name for motor-car drivers, they hit upon the word chauffeur. Just how much "scorching" of a more modern kind these up-to-date brigands of the road indulge in is best divulged by police records of fines for speeding.

This latest type airplane, intended for reconnoitering duty in the Marne sector, is just put together by expert workmen back of the French lines. It is built for speed



Slip knot through flat loop in wire. Pass cord again through loop and around ends. Bring it around and over other loop. Then the final lap and you simply slip it into the clip to hold it

A Package Handle That Saves Your Time and Cord

A COMBINED package carrier and tier invented by Friedrich O. Vontobel, a Swiss resident of New York, promises to be of considerable interest.

The pictures clearly illustrate the construction of the device and its application. At one end there is a flat loop of wire in the same direction as the handle, at the other end a flat loop at right angles to the direction of the handle with another bend at right angles to it near the middle of the loop.

This device saves time and cord. Before the tying is begun a knot has to be made in the end of the cord used for tying. No other knots are required.

The New Dandelion Extractor. You Can Work It Without Stooping

A NEW device for pulling dandelions has been invented by Hans C. Johnson, of Fort Bragg, California. It has a curved scoop for penetrating the earth adjacent to the plant. Pivotally attached to the shank of the scoop and opposed to it is a small toothed digger, which, when it is swung to closed position, impales or binds the plant against the scoop so that it can be readily extracted from the earth. This digger is linked to a slidable rod contained within the main stem of the implement. Two handles are provided, one for the main stem and one for the slidable rod. When the two are grasped and closed together the rod is pulled upward, causing the digger to swing toward the scoop to engage the plant. It will be observed that the person using this device does not have to stoop to conquer. Incidentally it is a fine weapon for attacking weeds on the lawn.

Without stooping, it is possible to "spot" every weed and uproot it with this new extractor

Fasting Is Not What It's Cracked Up to Be, Experiments Show

IT is impossible to stop eating and not feel the pangs of hunger. If you have been led to believe differently by the stories of men who have undergone fasting tests listen to the words of Professor Carlson of the University of Chicago. He found as a result of observation on man during prolonged intentional starvation, that the view that hunger mechanism fails early does not hold as a general rule. The professional faster, he points out, may ignore the pangs of hunger in a spirit of bravado.

Indian fakirs who have been practising the trick of fasting until the normal cravings of the body have submitted to will-power, are said to be able to go without food for incredible periods of time. But probably the real truth of the matter is known only to them.

The fumes of the volatile liquid are forced into the openings of the tunnels and kill every ground squirrel in them

Making a Gas Attack on the Pesky Ground Squirrel

FULLY a score of men, each carrying a mysterious long-handled container resembling a churn with an end of hose attached, have reached the field. They do not march in close formation, but scatter in every direction, apparently in search of something. First one then another stops, puts down his churn, fumbles with the hose and then grips the handle of his churn and begins to work it up and down like the handle of a bicycle pump. What are these men doing and why are they doing it? Is this war?—Yes, it is war—not against a nation, however, but against the ground squirrel, feared because of its destructiveness and because it is known to be a carrier of the germs of the bubonic plague and other diseases.

Under the direction of the United States Public Health Service these men are sent out to exterminate the ground squirrels by pumping the fumes of carbon disulphide, a highly volatile and inflammable liquid, into the tunnels of the squirrels.

Saving Time in Insulating Electric Cables

EVERY motion picture studio uses hundreds of yards of electric cable. It is important that the cable shall not be damaged when it is walked on or when a truck should run over it. Electric cables are therefore wrapped to protect them—an expensive business. To simplify and cheapen the process, William T. Kearns, mechanical superintendent of the Balboa Motion Picture Company, has invented a clever device.

Kearn's invention consists of a reel attachment for a serving marlin. A reel of twine is held in a metal frame and the twine is wound off the reel around a marlin onto the cable. The marlin is nothing more than a wooden mallet grooved to fit against the cable, and the frame holding the spool of twine is fastened upon the handle of this marlin. The device makes it possible to bind the twine tightly on the cable.

The device saves labor. In the older and more tedious method, one man did the wrapping while another passed the twine around the cable. With this device one man does both.

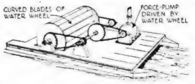
The inventor shows the old serving mallet and his improved substitute for same

This picture shows how the new serving reel is used for winding a cable by one man

Making Water Pump Itself

A novel water wheel obtains its motive power from the current

A CURRENT power wheel for raising water from running streams, which is said to be both efficient and inexpensive in operation, has been invented by H. C. Berry, of Portland, Ore., and has been successfully tested. The wheel is primarily intended for irrigation in the arid districts along the swift-flowing streams of the West.



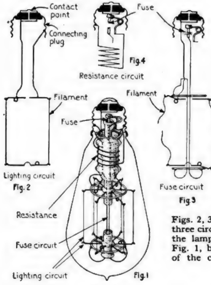
Power is transmitted from the water wheel to the pump by chain gearing

Water wheels of many different designs have been invented and many of them have been tested by the experts of the Department of Agriculture. Their high cost or practical defects prevented their coming into general use. Realizing that the key to the effectiveness of the power plant is in the wheel itself and depends upon the size, form, arrangement, number and depth of the blades, Mr. Berry made a thorough study of the subject and many experiments before he decided upon the particular construction of the wheel he uses in his invention. The curved blades, which are shown in the illustration, are the important feature of the wheel. Each blade is removable and independent of the others,—a great advantage when repairs are necessary.

The shaft of the wheel revolves in bearings resting upon the framework of the pontoon float, which carries, besides the undershot wheel, a force pump, driven from the water wheel by a sprocket chain gearing. With a current velocity of only four miles an hour, two six-foot wheels, each forty-four inches in diameter, developed two and one-half horsepower, enough to raise two hundred gallons of water a minute to a height of twenty feet. Successful tests have been made in the shallow Clackamas River in Oregon. Tests on a larger scale are soon to be made. The cost of a plant that will develop about 100 to 115 horse-power in a ten-mile current, is estimated at from $2,000 to $3,000. The cost of operating the plant would be almost negligible, however.


A current flowing at but four miles an hour will raise 200 gallons of water a minute to height of twenty feet. Two and one-half horse-power was developed in a recent test

Which Is the "Dead" Lamp on a Series Circuit? An Automatic Cut-Out Tells



Figs. 2, 3 and 4 show the three circuits embodied in the lamp separately and Fig. 1, below, a diagram of the complete lamp

WHEN an incandescent lamp which forms part of a series circuit burns out or when its filament breaks, all other lamps on that circuit are extinguished. The circuit must be bridged around the defective lamp. As all the lamps of the circuit are extinguished, it is a tedious task to find the exact lamp which caused the break. Each one has to be tested separately until the burnt-out bulb has been found. Not until then can the circuit be restored, either by substituting a good lamp for the one burnt out or by bridging over the gap in the circuit.

The incandescent lamp recently invented by F. Wybaillie, of New York, and shown in the accompanying illustration, aims to overcome these difficulties by providing a device which automatically cuts the filament of a "dead" lamp out of the circuit and places a resistance in the circuit so as to maintain it closed and balanced. Thus the remaining lamps in the circuit are enabled to glow on.

The inventor winds a resistance coil around a resistance carrier within the lamp in such a manner that the breaking or burning out of the filament will blow out a fuse. The spring held by the fuse is released, thus introducing the resistance in the circuit and bridging over the gap caused by the burning out of the filament. The trouble and inconvenience formerly caused by the burning out of a single filament in a circuit can thus be reduced to a bagatelle.

The Fifty-Seventh Variety of Armor for the Modern Soldier Appears

THE soldiers of old went forth to fight clad in cumbersome and expensive armor, which, while serving as a protection, nevertheless hindered them from putting forth their best fighting strength. To-day, Martin Jelalian, an inventor of Rhode Island, has made it possible for a soldier to be protected by armor. He is one of several dozen inventors who have reinvented the coat of mail.

The device is a bullet-proof metallic structure which surrounds the body and extends from the top of the shoulders to below the thighs. This steel coat consists of two like parts held together across the chest by means of straps. Hooks attach the coat to semi-cylindrical pieces of metal which fit closely about the upper part of the leg, and are fastened behind by straps. The inner surface of the armor is padded. The head is protected by a lined mask composed of the same metal

Clad in such armor our soldiers would indeed look like Martians or super-men

FOR PRACTICAL WORKERS

How to Make an Air Operated Metal Punch for the Shop

THE junk pile around a shop usually affords parts that may be of use from time to time. The punch here illustrated was made from such material. As it was necessary to punch a great many holes in some braces used in cars at a railroad shop, the master mechanic made up plans for using an old 8-in. brake cylinder for the power which was taken from a wrecked freight car. This cylinder was operated on about 100 lb. pressure, and its power, applied through levers, punched holes 9/16 in. in diameter in rough stock ½ in. thick. The controlling mechanism was made from a globe valve, changed to act like a whistle valve, the connections being made to a pedal.

Metal punch operated by an air brake cylinder

Keeping Foods and Eggs Fresh on Camping Trips

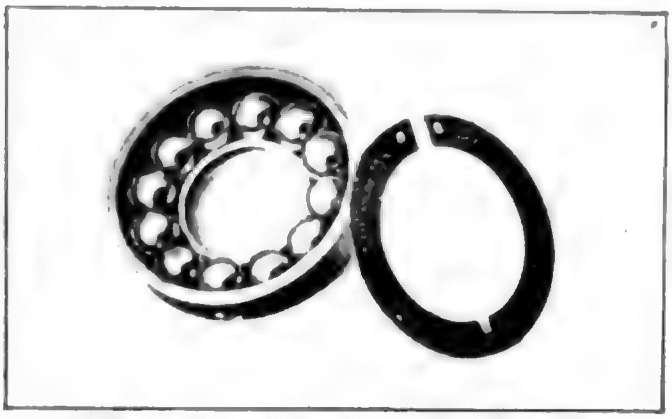
HAVING a touring car rigged out for camping, it became a problem how to keep butter and meat fresh. This problem was very satisfactorily solved by taking a single fireless cooker and clamping it to the running board of the car. A hole was bored in the bottom through to the inside and a brass tube placed in it, care being taken to solder the tube to the zinc lining of the fireless cooker. Then a hole was bored in the running board of the car to run the tube through. A wire rack was then made which came half way up the fireless cooker. Ice was put in at the bottom, then the rack and then on top of that the stuff to keep.

In one trip this improvised refrigerator was so efficient that it kept the ice for three whole days and three whole nights with the weather pretty warm. This was because the fireless cooker is pretty well insulated.

Another little trick is to keep eggs while camping. These were kept in mighty good condition by placing them in a friction top tin which can be obtained at all camping supply stores. This tin is on the same principle as the little tins in which you find spices and other commodities. First the tin was partly filled with ground cork. The cork, the kind in which grapes are packed, can be procured at fruit stores. Each egg is put in separately so that one will not touch another and surrounded by cork. Each tin will hold 14 eggs. These tins can be packed closely in a box and there need be no fear of breakage as the cork will absorb all blows and shocks.

Automobile Bearings and How to Care for Them Properly

THE bearings of the automobile are, to many motorists, as a closed book, into which they have never ventured to peep—they have been content to



The usual type of ball race with the ball holding ring and steel balls in place

let the garage man "turn the trick." In a way this may be a wise course, but, after all, it is more satisfactory for the motorist to learn and know his own car than to motor in a depend-on-someone-else manner. The bearings constitute one of the most important features of the motor car and for this reason, if he is thoroughly to know his machine, the motorist must give some attention to the bearings.

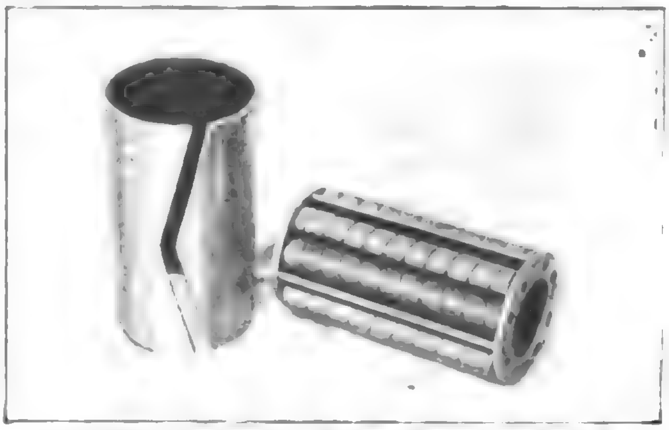
The bearings with which the modern automobile is equipped may be divided into three different classes—plain, roller and ball, the names themselves describing the types with considerable accuracy.

Plain bearings—The plain bearing consists of a cylinder which is open at both ends and split down the sides. Generally it is made of bronze and has a babbitt, a soft metal lining, this being situated immediately against the rotating shaft. The babbitt and its supporting metal are securely locked together, and as a rule there are grooves, running crosswise of the bearing or at an angle, cut in the babbitt to permit of even distribution of oil. These bearings are used as supports for the crankshaft of the engine and also for the lower ends of the connecting rods —where they connect with the crankshaft.

There is also another type of plain bearing, consisting of a bronze cylinder, without the babbitt lining, these usually being [illegible]ronze bushings. These are found at the top of the connecting rods, in the clutch, on the brake pedals, etc., or any other place where there is little danger of excessive heat being generated.

When the babbitted plain bearing becomes worn, the result is generally a knock within the motor. When this occurs it may be remedied by removing a shim, a very thin piece of metal located between the two halves of the bearing, or filing away part of the metal where the two halves touch. A laminated shim is made consisting of many thin steel layers and by removing one or more of these the offending looseness or play may be taken up. This babbitt-lined bearing requires perfect lubrication, for if the bearing is permitted to run dry excessive heat is generated through friction and the soft metal is quickly melted, or burned out, this being denoted by a pounding in the motor. The burnt-out or worn bearing should be replaced or repaired at the earliest possible moment, otherwise a ruined engine may result.

Roller bearings—These are cylindrical in form and vary in length. Each consists of a series of steel rollers which form this cylinder, and is divided into two main divisions—straight roller and tapered roller. There are radial roller bearings and thrust roller bearings and combinations of the two. These are generally

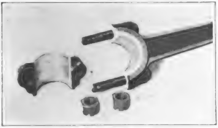


A roller bearing and its sleeve which is used on larger and longer shaft surfaces

used in the rear axle and rear wheels of the automobile. If one roller should become worn an entirely new bearing should be installed, for if all the rollers are not the same size the accuracy of the complete part cannot be maintained.

Ball bearing—This consists of steel balls which revolve between two holders or races. This is the most flexible bearing

known, and it consumes very little of the power passing through it. The ball bearing is divided into several classes. There is the annular ball bearing, which has races in the form of rings, and there is also the bearing which has a holder or race "L" shape, with curved sides facing the balls. This is known as the cup and cone



Connecting rod end with a split babbitted bearing that can be readily replaced

bearing, and these are adjustable, while the annular bearings are not. This type of bearing is also classified according to the way in which it carries its load, as thrust or radial. Ball bearings are built which withstand both radial and thrust load. Then again, bearings of this character are built which have two rows of balls. To work properly these balls must not vary in size more than one ten-thousandth of an inch. If one ball is worn through under-lubrication all of the balls of the set should be replaced with new ones. While oil is used to lubricate the plain bearing, medium weight cup grease should be used for the ball and roller bearings, and the best grade of grease is none too good.

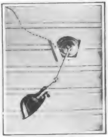
Every time the bearing is removed from the car it should be washed thoroughly in kerosene and dried on a clean, dry rag. The bearing should be kept free from water, dirt, grit, or other foreign substance, any of which might be sufficient to ruin the entire bearing assembly. Before replacing the bearing, after it is washed, fill it with new, clean grease. Caution should be exercised in tightening the bearing in its housing. See that the nuts are turned down evenly so as not to cramp the bearing in any way. The operator should never hurry in replacing the bearing. He should see that every step in the work is done right before proceeding.

Strengthening Hammer Handles with Steel Strips

A CLAW hammer of the usual kind with a wood handle may be made very strong for heavy work, such as pulling very large nails. This can be done by sawing out an opening in the handle from the hammer head back past the center of the handle an inch or two and inserting a strip of very narrow old steel buggy tire and securing in place by drilling small holes through both handle and buggy tire strip. The proper place for the holes is just back of the hammer head, one in the center, and one just back of the center an inch or two from the end of the buggy tire strip. Sometimes the drilling may be dispensed with by selecting a strip of buggy tire with bolt holes in the proper places.

A Wall Hanger for the Ordinary Electric Lamp Stand

THE illustration shows a simple device for using an adjustable electric stand lamp as a wall lamp at the head of bed or couch. The device consists of three strips of wood screwed to the wall in the shape of a half hexagon and three narrower strips nailed on to them so as to extend over the inner edge, forming a groove into which the base of the lamp can be inserted and held firmly. Being adjustable, the lamp affords a reading light at whatever angle the person reclining on the couch desires.—F. L. CLARK.



The desk lamp as it hangs on the wall

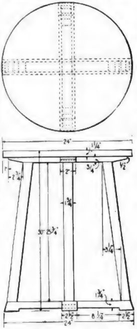
An Inexpensive and Effective Aluminum Polish

THE following is a fine polish for aluminum ware. It is made by mixing ammonia and water in equal quantities, and then adding the mixture to sufficient borax to make a paste about as thick as paint. Apply with a thick soft cloth and polish with canton flannel.

Constructing a Convenient Table for the Porch

PORCH furniture to be worthy of a place on the bungalow porch should possess individuality of type. The table described here is different from the conventional porch table and has a distinction of its own. The following bill of material gives the required pieces in lengths to make a cutting fit.


Pleasing design of a porch table that can be made of any sound wood and coated with white enamel


Details of the parts for making the porch table in a convenient size

4 legs 27 in. long by 2 in. square.
2 lower pieces 25 in. long, $2\frac{3}{4}$ in. wide and 2 in. thick.
2 cross-pieces $22\frac{1}{2}$ in. long by $2\frac{1}{4}$ in. wide and $1\frac{1}{4}$ in. thick.
4 top pieces 25 in. long by $6\frac{1}{2}$ in. wide and $1\frac{3}{8}$ in. thick.
12 $\frac{1}{2}$-in dowels 3 in long.
4 No. 8 flat head screws 1 in. long.
8 No. 14 flat head screws $2\frac{1}{2}$ in long.
4 No. 12 flat head screws 2 in. long with washers.
4 casters.
Small quantity of $2\frac{1}{2}$ in. finishing nails.

Saw out the two lower cross-pieces first and fit them together in the center with a cross lap joint, fastening them with two No. 10 screws. Next proceed to cut out the legs by squaring them up to size and cutting the ends to the correct angle. This can be found by drawing the table full size on a piece of wrapping paper and then obtaining the angle with a bevel.

The top pieces should also be cut and fitted together with a cross lap joint. Fasten these together with the two No. 8 flat head screws. It is best to glue the top up, using about four pieces to overcome any tendency to warping. Join the edges with glue and dowels, using about four dowels to each joint. While the glue in the top is drying, assemble the supporting part. Bore $\frac{1}{4}$-in. holes in the top and bottom cross-pieces where the legs are to be fastened, and countersink the holes. Before fastening the legs with screws nail them in place with the finishing nails and then insert the screws. Draw the screws up as tight as possible, and the table parts will be held together solidly.

The top should be planed and then scraped and cut out to size on a band-saw. Smooth up the edges and surfaces carefully with sandpaper. The top is then fastened to the table with screws run up through the cross-pieces. The holes for the screws had better be slotted and a washer put under the screw heads so that the top can shrink and expand readily. After the entire surfaces of all parts have been well smoothed with sandpaper it is ready for finishing. White enamel makes a very fine finish for porch furniture. It is applied as follows: First put on two coats as a base, allowing time for drying thoroughly between coats; then apply the finishing coat. Allow three days for the last coat to dry. Then the table is ready for use on the porch. As the wood used in its construction may be of any soft variety it is not difficult to make and join the parts snugly together so that there will be no seam to show after the surface is coated with the enamel. The same table can be made in quartered oak and stained to match furniture for a room, or constructed of mahogany or birch stained mahogany and used with other furniture to match for the home. The design is such that it will adapt itself for use in either case.—HARRY W. ANDERSON.

A Garden Barbecue

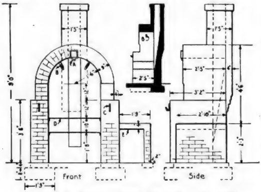
An outside fireplace with the added feature of grids for grilling fresh meat

By Huntington Baker

THE out-of-door fireplace has become a popular feature with many of the more luxurious dwellings of the West. This is usually designed to form a part of the terrace or veranda of the house, and its purpose is manifestly to combine the cheer and comfort of the open fire with the fresh, free air of the outside. Where the grounds are extensive or secluded enough to permit it, a somewhat different style of open-air fireplace has been designed, to be built generally in a clearing, apart from any building. The charm of this feature lies not only in the comfort accorded those who gather round, but in the fact of its being so constructed as to provide also, every detail necessary for the preparation of a steaming-hot meal. The garden barbecue may be built of stone, brick or concrete, and is adaptable to slightly different forms of ornamentation.

The open-air fireplace on the grounds of an estate where barbecues may be held and refreshments served

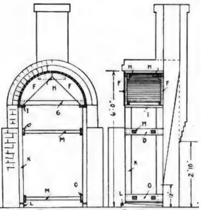
The accompanying measured drawings have been made from a typical brick example now standing in the grounds of a western country estate. This model is a practical one, not too expensive, and comparatively simple in construction. It requires about 1,700 bricks, with 3 bu. hydrated lime and 1 cu. yd. of sand for the mortar. The fittings may be secured from a blacksmith. At *A* is a wrought iron collar-strap 3/16 in. by ¾ in. made to fit around the keystone which projects to receive it. At *B* are two ½-in. eye-bars anchored to the soffit of the arch, which form, with the collar-strap, loops from which may be suspended wires or chains to hold a kettle or cauldron. At *C* are two iron hooks built into the joints of the brickwork for supporting the ends of an iron rod placed across the opening to serve as a spit or as rests for the ends of long forks or prongs thrust into the fire. At *D* are shown two shelves or grids made from corrugated wire mesh set into a frame which fits snugly into the grate on angle-brackets. These grids are removable and serve also for use in the smoking and



Plans of the fireplace giving dimensions of a good size to cook food sufficient for any entertainment

grilling of fresh meats. Attached to the main body of the barbecue is a shelter for fuel. At *E*, sheet-iron strips are used to support the bricks of the roof.

To one who has a general knowledge of



Skeleton framework for building the bricks over in making the barbecue fireplace

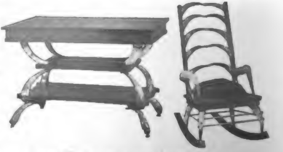
brick-laying, the making of such a barbecue is no great task. Special care should be taken with the semicircular arch which is turned on a wooden templet or centering, shown in the diagram. The faces of the centering are composed of two pieces of 1¼-in. planking, sawed to the proper arcs as at *F* and braced at the bottom with ties, *G*, and at the top with fish-plates, *H*. Across the face pieces are nailed lagging-strips 1¼ in. thick by 2 in. wide and 2 ft. 5 in. long. The face pieces rest on caps *I*, under which the supports, *K*, are placed. The centering must be made shorter than the actual height of the opening to allow its base to rest on two slip wedges, *L*, which are loosened after the masonry has set, thus allowing the arch to settle down gradually to its own bearing. The wedges when withdrawn also allow for removal of the centering without injury to the bricks. The braces, *M*, are inserted between the cleats, *O*, to hold the supports in a vertical position against the jambs of the opening. The chimney is corbelled out in the rear so as to allow the flue to start at a lower level, thus making the draft more efficient. Of course the height of the chimney is variable, according to conditions, but 9 ft. is a good height for ordinary circumstances. A brick hearth in front of the fireplace is an added convenience.

Such a fireplace can be built in a wall on the back yard of a lot or where the grounds are small and form a part of a garden bric-a-brac. In this instance the dimensions can be changed to suit conditions.

Cow Horns Effectively Used in Library Table and Chair

A NOVEL use for cow horns has been discovered by an ingenious craftsman. He has found a means to use them for making furniture.

The illustration shows that the result is not only practical, but presents a unique and decidedly ornamental library table and chair. The horns proved adaptable as well as very substantial. They are tastefully mounted with copper, and in the table form the entire upright construction, the quartersawed oak boards having no other support. In the chair the same general plan is followed, the horns being used as the support, and riveted together at the top to form a comfortable and well shaped back. The lines of both table and chair very closely resemble the design followed in Oriental furniture. Both pieces are rigid, and have



A very effective use of cows' horns in the construction of a library rocking chair and table

been tested to stand a heavy strain. They form a pleasing addition to any library or den, their novelty attracting attention.—L. N. JOHNSON.

Open Canoe Cruising

III.—The construction of the lee boards, their location for handling the canoe under sail. Stowing outfit, making a landing and the canoe as a fishing craft

By E. T. Keyser

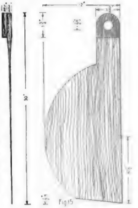
IN order to sail to windward, lee boards will be needed. Square up two pieces of ¾-in. mahogany, oak or cherry, each 30 in. long by 12 in. wide. On the lower left edge, make a mark 1½ in. from the lower left corner. Lay a line from this point to the lower right corner and saw along this line. With a marking gage, run a line 3¾ in. distant from the right edge at the top. On the right edge, mark a point 10½ in. from lower right corner and, with this point as a center, describe an arc with a 12-in. radius from the bottom of board to the line which runs parallel with right edge. Cut out this arc with a compass saw and rip along the parallel line from the top of the board to the arc.

The lee boards as they are fitted to the canoe gunwales for sailing to the windward

From the waste, cut out two pieces each 3¾ in. square and screw them to the head of the lee boards as indicated in the cross section view. Through center of this square, bore a hole 1½ in. diameter through both lee board and reinforcement and round off the tops of lee boards as shown in Fig. 15. Work down the front edge of the lee board as shown in the cross section; apply a couple of coats of linseed oil with a soft cloth, allowing the oil to soak well into wood between coats, and finish with three coats of varnish well rubbed down between each coat. The lee boards are fastened, one to each end of a 1½-in. axle, by means of sash pins for which holes are bored through both tops of lee boards and axle and are held to the canoe by two straps passing around the ends of the axle and thwart, as shown in illustration. A brass tube long enough to reach from gunwale to gunwale and encasing the axle would allow the lee boards to lower and rise more freely, with tighter buckling of the straps.

A halliard, leading from one of the sash pins to a small cleat fastened to the inwale, on being pulled in will lower the boards for going to the windward while their buoyancy will cause them to rise when the halliard is cast off from the cleat. Pulling out the sash pins allows the removal of boards from the axle and the whole outfit stows compactly when the canoe is under paddle.

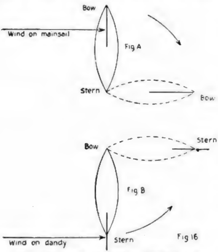
The proper location of the lee boards, the position in which they allow the canoe to do the best windward work, is best found by experiment. Should the best location lie between the thwarts, a pair of large brass screw-eyes may be set into inwale to take the holding straps.



Details of a lee board for use in canoe cruising

The principles of sailing a double rig canoe may be easily understood by studying Fig. 16. In *A* is shown the tendency of the wind pressure on the mainsail to make the canoe pivot on her stern and throw her bow away from the wind, increasing the tendency to capsize. In *B* is shown how the pressure of the wind on the dandy tends to cause the canoe to pivot on her bow and

face the wind, reducing the wind pressure. The mainsail may be regarded as the driving sail and the dandy as the means by which one may round up into the wind and spill the pressure which may threaten to overturn the canoe. This is accomplished by letting out on the main sheet and letting the dandy act as the after



The principles of sailing, showing the tendency of the wind on the mainsail

portion of a weather vane, whenever the wind becomes too strong. A canoe rigged as in the previous article will always tend to point up into the wind and spill the pressure, and can only be kept from luffing by means of the steering paddle which is carried over the same side of the canoe as that over which the main boom is swung at the time.

To hoist sail, trim in dandy sheet so that the boom is amidship, push away from the beach or float. Hoist the dandy and when the canoe has swung around with its head to the wind—and not before this—hoist the mainsail, letting the main sheet be free. Then let out the dandy sheet, pull in the main sheet until the canoe has headway and, when you have gathered steerage way, enough speed to allow of steering, point the canoe on your course. Never lower the dandy first. Always head up into the wind, lower the mainsail and then the dandy.

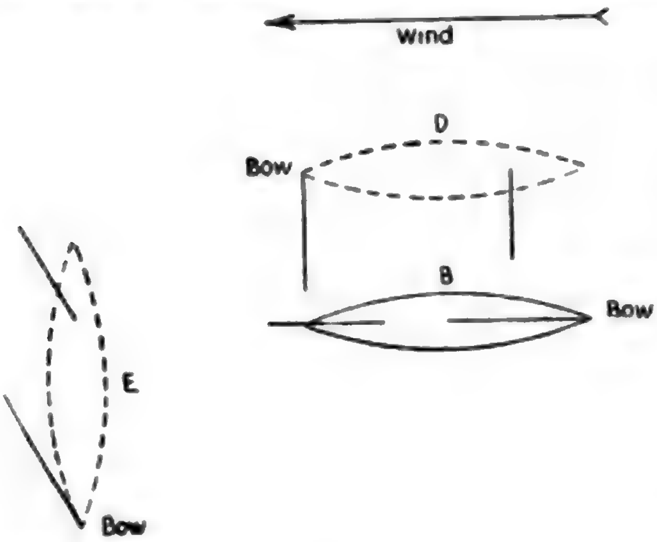
When going about, coming back over the same course that you have sailed, turn the bow of the canoe against and not with the wind. The correct method of doing this is shown in Fig. 17. The arrow shows the direction of the wind. The canoe with a beam wind, is shown at *A* and when the canoe is headed into wind, as at *B*, the wind is spilled from sails and booms amidship, and *C* shows the canoe with the booms on the opposite side and retracing her course. Note that at any time between positions *B* and *C* the canoe may be luffed up into the wind and the pressure spilled.

The improper method is shown at *D* and *E*. At *D* the sails must catch the full force of the wind and the location between *D* and *E*; the booms must go across the canoe with a "flop" which may capsize her. "Gybing" it is called. Furthermore, at no point between *A* and *B* can one ease up by luffing and one must take the full force of the wind without ability to spill any of the pressure. A long narrow and light boat, like an open canoe, has very little momentum when rounding up and some help from the paddle may often be necessary between positions *B* and *C*, but do not be tempted to adopt the other method.

To go about, slacking up on the main sheet and easing up on steering paddle are all that are necessary. When sailing with a beam or a stern breeze allow the lee boards to rise. When tacking, lower them by the halliard. Always have them raised when paddling as they cause considerable drag.

Sailing dead ahead of the wind is the most ticklish part of canoe navigation. The area of the sail that a canoe can carry ahead of the wind is what governs her maximum spread, as the canoeist's weight in this case cannot be opposed to the wind pressure. Also, there is the tendency of the sails to gybe at the slightest shift wind or variation of the canoe's course. This tendency may be recognized from a desire of the main boom to raise or "hike" and should be promptly counteracted by steering a bit away from the side over which the boom is laying. With the wind directly astern and both booms on one side, the dandy will blanket the mainsail to a certain extent and there will be more of a tendency of the canoe to round up. This necessitates carrying more pressure

on the steering paddle which diminishes the headway. It is therefore good seamanship to carry the sails "wing and wing" or with the main boom over one side and the dandy boom over the other. This allows both sails to draw to their full capacity and also reduces the drag from the steering paddle. In event of a tendency to gybe, keep the mainsail full and let the dandy do the gybing as its area is so small that it will not cause



any damage.

Often it will be possible to tack against or take as a beam wind one that is too heavy to run before with the full rig. When it becomes necessary to run before it, round up, lower the mainsail and then scud before it under the dandy alone.

Fig.17

Turning methods in a course

In very heavy weather, the canoe may be turned stern first, the dandy sheet unrove from the deck ring and held in one's hand and the canoe sailed stern foreward under the dandy only. It is well to experiment with the canoe rigged thus, so that you may know just where to place the lee boards so that they will be correctly located for the dandy in this position.

When sailing with a passenger, both of the crew should face forward and the passenger given the management of the lee boards. It is better that the steersman handle the main sheet as he can co-ordinate his actions with paddle and sheet better than two parties could possibly hope to do.

With an outfit aboard, it is best to have considerable weight up forward, if much tacking is to be done, as a canoe somewhat down by the head will make better windward work. The reverse will hold for a long run ahead of the wind in which case it is best to have more weight aft. A passenger, serving as live ballast, can prove quite useful in this respect.

In making a landing at a float or dock, always come up to the landing against the wind or tide, whichever may be the stronger, and when leaving the canoe temporarily tied to a landing, tie her on the side away from which the wind is blowing so that she may ride clear without bumping or scraping. Often, when a light breeze is blowing, the hoisted dandy with boom trimmed amidships will keep the canoe well off the landing against a tide which would tend to run her against the float or dock.

When landing on a beach, except on a falling tide, always pull the canoe well above high water mark, as you may be away from it longer than you had figured upon and a rising or shifting wind might pound her on the sand.

When landing on a rocky shore, unless you can be sure of enough sandy bottom to accommodate the canoe, step overboard and wade ashore before the canoe touches bottom, dragging the canoe until she grounds. Unload her before dragging her up on the beach and load her with only the bow grounded when you embark. Dragging a heavily loaded canoe ashore or down a beach will do her more injury than five seasons' legitimate usage.

One of the chief beauties of a canoe is her adaptability as a fishing craft. With her one may hoist sail, run out to the fishing ground and return under canvas while the other anglers are raising blisters on their hands.

For fishing, it is best to have the canoe anchored by the stern, as then the fisherman will face the direction in which his line is pulled by the tide or his float is blown by the wind. After the mainsail is lowered, the boom may be removed from the mast and the forward end of the sail pushed up under the forward deck

and the after end laid across a thwart out of one's way. The dandy, having a lazy jack, will take care of itself and give no trouble.

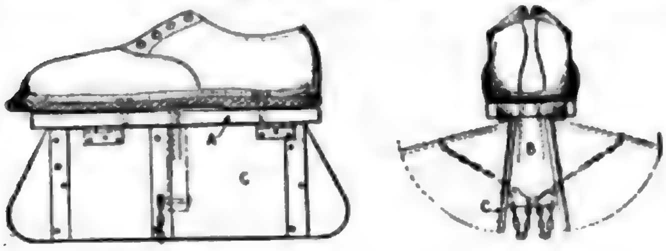
It is well to have a rod long enough to allow the line being passed from side to side of the canoe at will, by passing the rod tip over the main mast head and carrying the line across the bow. This is easily accomplished as the canoe is anchored by the stern. If the fish run to any size, a landing net will prove a great convenience and save many fish.

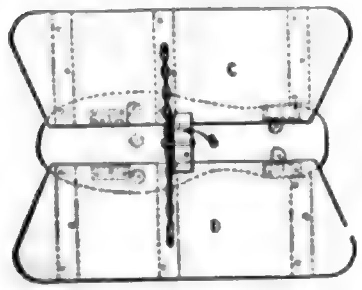
Fishing in a small river, such as the Delaware, the stern anchor is a necessity as it allows one to drift with the current and drop anchor and raise it without changing the downstream direction of the bow.

(To be concluded)

Wing Attachments on Shoes to Aid the Swimmer

BEING denied the privilege of entering into a swimming contest because he was too young, a boy determined to beat the winner at least and this is the way he did it: To an old pair of tennis shoes he attached the wings as shown in the illustration. A sole of wood, *A*, was attached



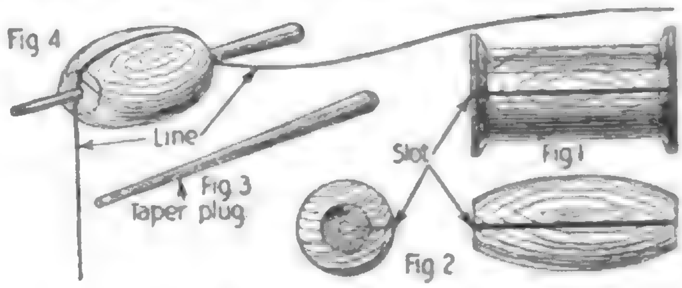


Wings fastened to a wood sole on a tennis shoe to make an aid for fast swimming. They won a race for the wearer

to each shoe and in its center a vertical piece, *B*, was securely fastened. These pieces were cut slightly tapering toward the top. Wings *C* were attached to the wood soles with hinges so that they would lay against the vertical pieces. A chain was attached to the lower end of the vertical piece and to the wings so that they would come to a stop at almost full spread. It is obvious how these wings worked as the swimmer made his strokes. On the day of the race the boy hid the prepared shoes in some long grass near the shore and when the contestants started he quickly undressed, slipped on the shoes and easily beat the winner over the course.—WM. R. HUNN.

A Fishline Float Made of an Ordinary Thread Spool

WITH a float of this type I find the operation of taking on and off a line, as well as of setting for depth, is



A thread spool shaped and fitted with a tapering pin to make a fishline float

accomplished much more quickly than with other floats I have used. A small or large spool, Fig. 1, is trimmed out as shown by the dotted lines, into the shape of Fig. 2. A fine saw cut is made until it connects with the hole in the spool. Through this cut the line is inserted and fastened with a taper hardwood plug. The float can be painted or not, but both float and plug must be given a coat of hot paraffin inside and out.

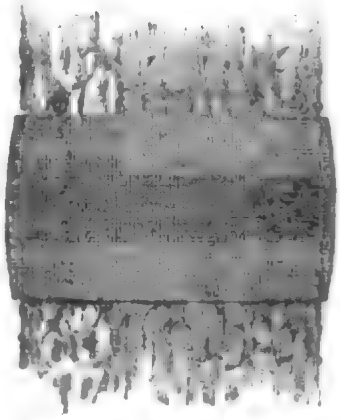
Convenient Material for a Bait-Catching Net

THE fisherman who angles only occasionally usually neglects to supply himself with a bait catching net, and so at the last minute has to seize on the nearest fabric that will not hold water.

If, however, he visits the nearest produce market or grocery store and for a few cents buys one of the ventilated sacks in which onions are shipped, he will have material for either a bait catching net or landing net. These bags are strongly woven in 1/8 in. mesh and will furnish a square of material about 3 1/2 ft. by 3 1/2 ft., which can be conveniently attached to any net frame. Evidently any material strong enough to hold onions will prevent a fish from breaking it.—JAMES M. KANE.

Banding a Tree Trunk to Catch and Destroy Moths

WHEN the codling moth larva has done its best to destroy the appearance of the ripest and rosiest fruits it can find, it seeks a place to spin a cocoon, and for this purpose it generally crawls up or down a tree trunk. Hence the usual method of trapping the moth is to wrap a band of burlap around the tree trunk. An improvement on this method, devised by E. H. Sigler, of the United States Bureau of Entomology, employs a wire screen over the burlap band to form a trap into which the larva enters and spins its cocoon, but from which it cannot escape as a moth.



A burlap band covered with a wire screen

To make the trap, strips of burlap six inches wide are folded into three thicknesses. The loose bark from the lower branches and trunk of the tree is removed. A strip of this burlap is folded once around the trunk and held in place by large tacks, driven in such a way that the edge projects about one-fourth of an inch beyond the burlap. Black-painted wire screening with twelve meshes to the inch is then cut into strips six inches wide, and the edge of each strip is folded twice, allowing one-fourth of an inch to each fold.

The strip of screening should be long enough to allow for an overlap of three to four inches when placed around the tree over the burlap. It is tacked to the tree so that both the upper and lower edges fit snugly against the bark. The projecting tacks used to fasten the burlap prevent the wire from pressing against the cloth. To make sure that no moths can escape through the openings along the edges of the trap or along the flap, a thin coating of pitch tar may be used.

The traps may be placed on the tree during the winter or in the spring, not later than one month after the petals have dropped.

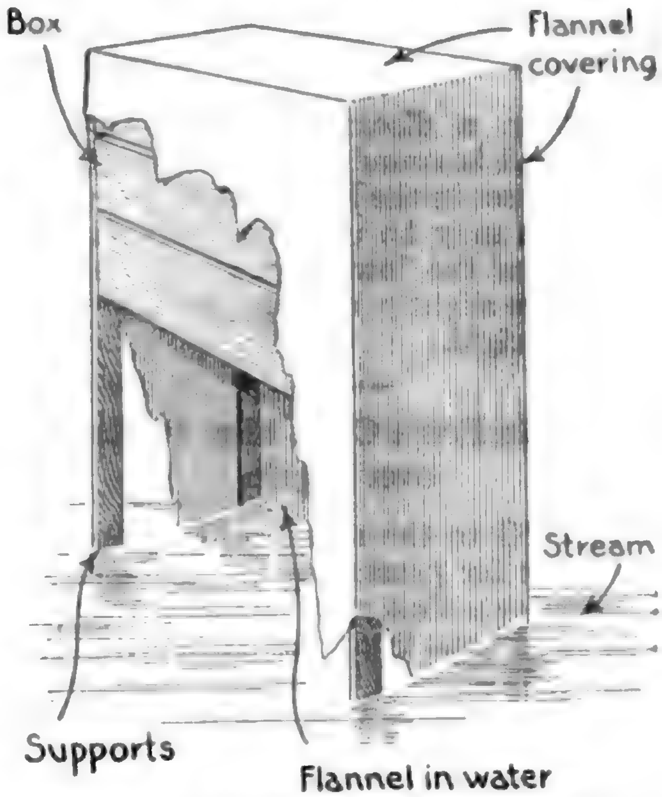
Cleaning the Gilded Portion on Picture Frames

GILT picture frames and chandeliers will, in the course of time, get dirty and turn black. Procure a box of wall paper cleaner and rub some of it over the gilt frame or chandelier. This removes the grease and dirt. Next boil some onions in water so as to get a strong solution. Dip a soft cloth in it and wipe over the frame, polishing with a dry cloth.

Cooling Camp Food by the Evaporation Method

AWAY from an ice supply it is often difficult to keep the food in good condition when no spring is near. However, a very efficient refrigerator that will go a long way in keeping the camp food fresh can be made from a small wood box mounted on stilts as shown in the illustration. Shelves and a door are put in to hold the various dishes.

The whole is then covered with flannel which reaches down into the water below.



Wood box cloth covered and mounted on stilts in a brook to keep food by evaporation

The evaporation from the cloth will cool the contents of the box in a very efficient manner. Such a device also keeps the food away from the crawling things that infect the woods.—THOS. W. BENSON.

A Rocking Board See-Saw for Children's Playground

THIS excellent piece of furniture for the playground or porch may be easily made of a board and segments of

A board with attached segments of a wheel rim making a see-saw rocking board for the children's playground

rims from a discarded carriage wheel. The board is rounded as shown and the segments set in the board edge. Supporting strips may be used under the board and across the lower part. These segments are slightly set out, as shown, to make it rigid.

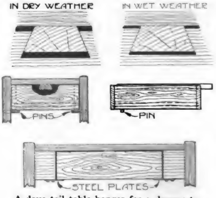
Old Tin Fruit Cans May Be Used over Again

OWING to the scarcity of tin, patent cans for preserving fruit will be expensive for a time at least and difficult to obtain. If one is careful in opening the cans of fruit and vegetables purchased from the grocery store the cans can be used in the following manner: Thoroughly clean and dry the cans as soon as contents are removed and store them away in a dry place to keep them from rusting. When ready to use them again fill the cans to within 1/4 in. of the top and then pour melted paraffin in to fill them. Tie covers on of waxed paper and the contents will be preserved as well as in the patent can or glass jar.—L. GERMAINE.

An Overhead Dove-Tail Suspension for Table Drawers

THE method of hanging a drawer here illustrated will be found a simple and satisfactory way out of a difficulty which is often encountered. This way is practical anywhere where a light drawer, such as is used in library tables, sewing cabinets, and the like, is to be placed in a limited space and a bottom slide and rail are either not possible or undesirable.

The construction simply consists of a dove-tail tongue engaging in a correspondingly shaped notch in the upper edge of the rear end of the drawer, the tongue being fastened either direct to the table-top or to blocks, if the drawer does not come right under the table-top. In front it runs on two pins driven into the table-legs and set back about 1 in. to be out of sight, or, if the drawer does not occupy the entire space between the legs, on a couple of small steel plates screwed



A dove tail table hanger for a drawer to eliminate the sticking drawer slides

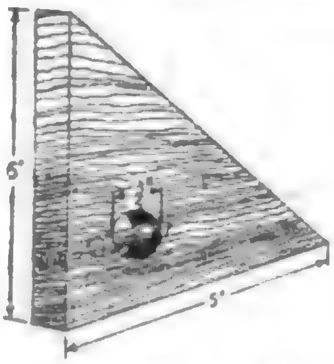
to the edge of the side-ends and protruding about 1/2 in.

This way of suspending a drawer has many advantages. It is extremely simple

and requires very little work, and it gives the greatest possible amount of usable space. If properly put in, it will never bind because the points of contact are small and any swelling or shrinking of the working parts are automatically compensated. Therefore, an extremely close fit can be made without any fear of trouble later. This method is far superior to the usual way of hanging such drawers by grooves in the sides which engage tongues, and where any slight warping or swelling of either side or tongue immediately produces binding, unless a very loose fit has been made. It makes for good appearance, too, there being no unsightly grooves to show in the sides when the drawer is pulled out.—HENRY SIMON.

How to Make a Pocket Plumb and Level in a Block

THE only materials necessary to make this most serviceable little tool are a plain level glass and a small hardwood block. The block should be from ½ to ⅝ in. thick and triangular in shape, the angle of one corner being a right angle and the sides equal. Draw the hypothenuse and on it mark the center of the sight-hole. Through this, and parallel with one side, draw a line and square it across one edge. Mark the center and bore a hole just large enough to admit the level glass, keeping the bit straight by sighting along the pencil line. The bore should go just deep enough so that the center of the level glass will coincide with the center of the sight-hole.



A level glass set in a triangular wood piece

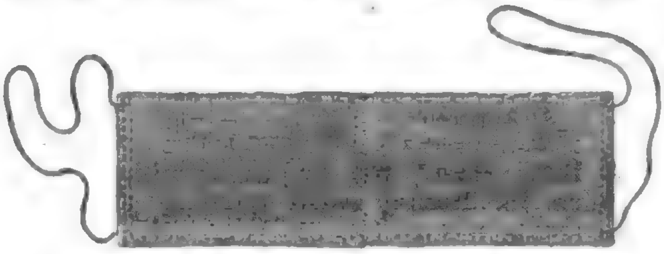
Now bore the sight-hole with a ¾-in. bit. Put a few drops of glue into the end of the bore for the glass, slip the glass into place, drop a little glue on its end, and seal the hole with a dowel.

The level should now be left untouched until the glue is set, and then the edges trued up with a block-plane, care being taken to true up the long edge also.

This level is very light and fits the pocket. It accomplishes with one level-glass what it ordinarily takes two to do and not only that, but it permits truing-up work inclined at an angle of 45 deg. to the horizontal, which is at times extremely useful. It has another advantage, too—it can be used to lay out miters when no other tool happens to be at hand. —HENRY SIMON.

Making Camp Hammocks from Gunny Sacks

PERSONS contemplating camp life during vacation in almost inaccessible spots may, with a little forethought, provide themselves with some of the luxuries of the home. For instance, the hammock, which is difficult to carry, can be made from large bran or peanut sacks in which the outfit may be packed for transports. At the camp cut round sticks as long as the sack are wide, attaching a strong cord for a hanger at either end and drop one into the bottom of each sack, passing the cords out between the meshes at the corners. Sew the tops of the sacks together with strong twine or string and the result will be a hammock that, when suspended between two trees, is a near approach to a spring bed. The sacks may be used for the duffle on the return trip—GALE PINCHNEY.

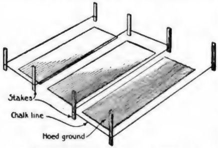

Two bran or peanut sacks sewed together with a hanger at each end for a hammock

A Cement for Mending Valuable China Dishes

VALUABLE china may be mended with the following mixture, and when dry it will resist hot water and ordinary usage. Mix a teaspoonful of alum and a tablespoonful of water. Place in a hot oven until it is quite transparent. Wash the broken pieces in hot water, dry and put them into the oven until they are warm; and while still warm coat the broken edges with the mixture thinly and quickly as it sticks instantly.

Stakes with Guide Lines for Hoeing Garden Beds

FREQUENTLY the gardening enthusiast plants the seeds and then forgets all about them. When next he views the patch he is unable to tell the weeds from



A line around the stakes furnishes a guide for hoeing small growing plants

plants. Here is a sure plan that will enable him to hoe out all the weeds possible without cutting the little plants. Always mark out the ends of each row with proper stakes, marking the stakes with indelible pencil with the name of the plant in the row. When hoeing or weeding time comes, run a chalk line along the rows from stake to stake as shown in the sketch. This will give a guide line alongside of which one can hoe as close as he desires. The remaining weeds, being mixed with the plants will, of course, have to be weeded out by hand to prevent their injury.—JAMES M. KANE.

A Combination Camp Kitchen Cabinet and Table

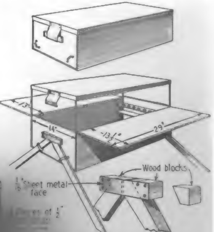
THE combination cabinet and table illustrated was the result of the refusal of my family to take a long outing unless they could carry some conveniences with them. "Roughing it" did [illegible] appeal to them. The [illegible] modate four [illegible] extra compart[illegible] required.

The [illegible] in. [illegible]

[illegible] each wing is an L-shaped piece of metal ½ in. wide and ¼ in. thick. These are fastened with screws, making the wings 29 in. long over all. These iron pieces are put on so that the end not fastened to the wing will stand in a vertical position as the wing hangs out from the box.

The cover is made of sheet metal with the edges turned down and the corners riveted. The inside measurements are such that when it is slipped over the top of the box it will fit snugly. The upper ends of the vertical pieces of metal fit into the corners of the metal cover when the wings are extended and will prevent them from dropping farther than a horizontal plane.

The inside of the box may be arranged to suit the individual builder. On the ends of the box are fastened blocks of wood cut as shown. A metal strip is fastened across their faces to form a pocket for the upper ends of the legs. Two saddle strips are also fastened to the ends to slip the legs through as shown. The metal cover has two clips fastened to



[illegible] kitchen table and cabinet for mak[illegible] every convenience of the home

[illegible] These clips project and form a [illegible] catch under the blocks for the [illegible] of the legs, and hold it in place [illegible] folded for shipment.

[illegible] opened up as illustrated it pro[illegible] a raised table top and two wings. [illegible] leaves the contents of the box ac[illegible] while at lunch.—J. D. BOYLAN.

Simple Designs for Sheet Metal Working

XIII.—Other interesting problems developed by means of radial lines

By Arthur F. Payne

Director of Vocational Education, Johnstown, Pa.

THOSE of you who have worked out the radial line problems as demonstrated in the last two issues will have acquired an understanding of the fundamental principles of the methods of pattern development by means of radial lines, that will make these more complex problems easy to understand and develop.

The new points introduced in these problems are the use of old principles in new ways, and the use of short cuts. If any difficulties are experienced in working these problems it will be of advantage to review the problems of the last two issues.

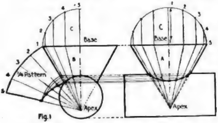


Fig. 1

One method of developing a pattern to make a hopper for entering a round pipe

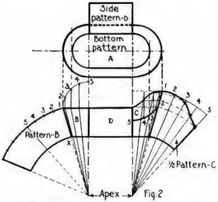
The illustration (Fig. 1) shows the method of developing the pattern for a hopper entering a round pipe. A more technical statement of the problem would be "the development of a cone intersecting a cylinder;" sometimes these technical statements are confusing if the terms used are not understood. In the previous problems, the base of the cone has always been placed at the bottom; in this one the base is at the top and the apex at the bottom; this makes it appear different, but the method of developing this problem is exactly the same. Another new point is that to save time and labor we have developed only one quarter of the pattern, using only one-quarter of the bottom view. The steps taken for the development of the pattern are as follows:

First, draw the front view, *A*, the exact size wanted. Before we have gone very far we shall find that we cannot complete the front view without the aid of the end view, *B*. The joint line of the cone and cylinder is not absolutely necessary to develop the pattern, and the method of finding the joint line has been explained earlier in the series, but as this problem offers a splendid chance to review, it is deemed advisable to take advantage of the opportunity. Second, to complete the front view by drawing the joint line, we must draw the end view, *B*. Third, draw the top view, *C*, of the base of the cone on both front and end view, divide these half circles as usual and project the points to the base lines and then to the apex. Fourth, be very careful about numbering these points as a mistake will cause a lot of trouble. In the front view point number 1 is in the center of the base line and at the top of the half circle as indicated by the arrow line, but on the end view the same point number 1 is on the left hand side because we are looking at the problem from a different view point. Fifth, to get the joint line on the front view, *A*, project lines across from end view, *B*, where the radial lines from the base to the apex cross the joint line between cone and cylinder. On the front view, *A*, where these projected lines cross the same numbered lines going from the base to the apex, place a cross, then connect these crosses with a freehand curve and the front view will be complete.

To develop the pattern will be easy enough for the students of this series who have completed the preceding problems. Briefly the steps are: First, draw the pattern arc, 1-5, getting correct length by stepping off the spaces from the top view, *C*. Second, project the radial lines from the point of intersection with the joint line to the line apex-1, to get the true lengths as was done in all the preceding problems. Third, swing these lines over to the pattern until they cross

the same numbered lines, then make a cross, connect these crosses with a free-hand curve and the one-quarter pattern is complete.

The illustration (Fig. 2) shows the method of developing the pattern for a bath



A pattern for a bathtub is developed in a similar manner to a hopper and pipe

tub. Notice that the tub is made up of five parts, bottom, two ends and two sides. The pattern for the bottom needs no development as the top view, *A*, gives us a true pattern. The patterns for both ends and one side must be developed in exactly the same manner as that described for Fig. 1, and will not be repeated here. Notice that it is one-half of a cone and developed in the same manner as for the hopper and pipe.

The pattern for the end, *C*, is developed in the same manner, except that the base circle has been drawn downwards instead of upwards as was done on end view *B*. This method is often used and was introduced here so that the students of this series might become familiar with it. The base circle is divided and the points projected to the base line, then to the apex in the usual manner. The points where the radial lines from base to apex cross the curved line of the tub are projected over to line apex-1 and then swing across the pattern until they cross the same numbered lines in exactly the same manner as described for previous problems.

The pattern for the side, *D*, is easily drawn. The correct width is obtained from *D* front view. The height is not correct on the front view because the top edge is leaning towards us. The correct height is obtained from the line, 1-X. It is the same height as the side, *D*, and has the same angle of inclination or slant, therefore, the line, 1-X, is the true height of the side, *D*. Set off the width from *D* and the height, 1-X, and the pattern for all parts is complete. Allowance must be made on these patterns for seams, and wiring as shown in previous issues.

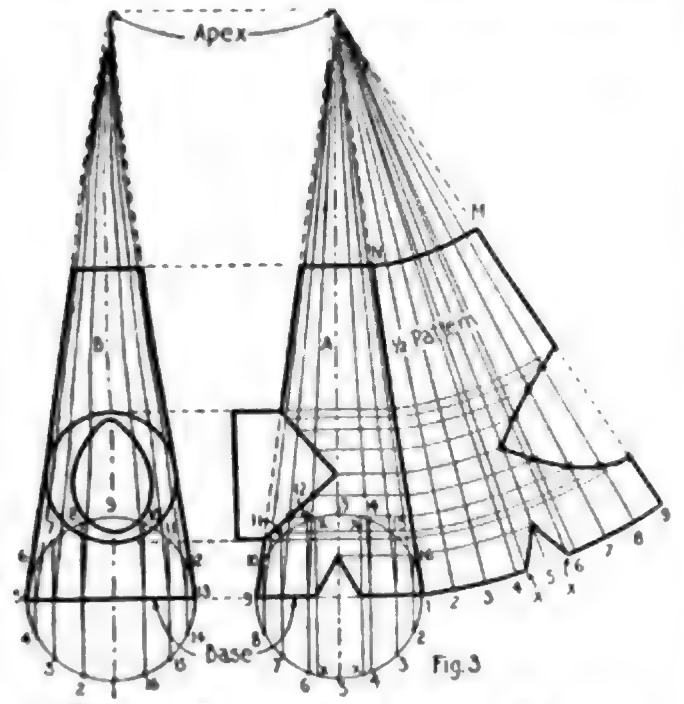
The illustration (Fig. 3) shows the development of patterns for an "egg tester." A lighted candle is placed inside and the eggs are held against the egg-shaped hole. This must be done in a dark room. If the egg is clear and transparent it is fresh; if cloudy it is old. If it shows a dark spot, the process of incubation has started. The V-shaped hole at the bottom is to admit air so that the candle will burn brightly.

The technical description of the problem would be "development of pattern for a cylinder intersecting a truncated cone." As stated before, these terms are often confusing to the non-technical reader, but advanatge should be taken of every opportunity to become familiar with them.

The development of the pattern for the round pipe (cylinder) has been described so many times in various ways in this series that no further description is deemed necessary, neither is it shown in the drawing. The best explanation will be found in the December, 1917, issue, "Development of Pattern for Tee Joints." The egg-shaped hole is drawn freehand.

The development of the pattern for the cone gives us an opportunity to review the use of auxiliary points and to make use of a still different method of drawing the bottom view and base line circle. The steps taken are as follows: First, draw front view *A* and side view *B*. Second, complete the cone by continuing the side lines until they meet at the "apex." Third, draw the bottom view, that is the circle on the base line. Notice that this is the first time that we have drawn the full circle on the base line. In previous issues it has been dropped down some distance from the front view to avoid confusion, but it is now time that we become acquainted with these different

methods. Fourth, divide the circle into sixteen equal parts. Project lines from these points direct to the base line, then direct to the apex; these are the radial lines. Fifth, from where these radial lines cross the joint line of the cone and cylinder, project lines straight across to

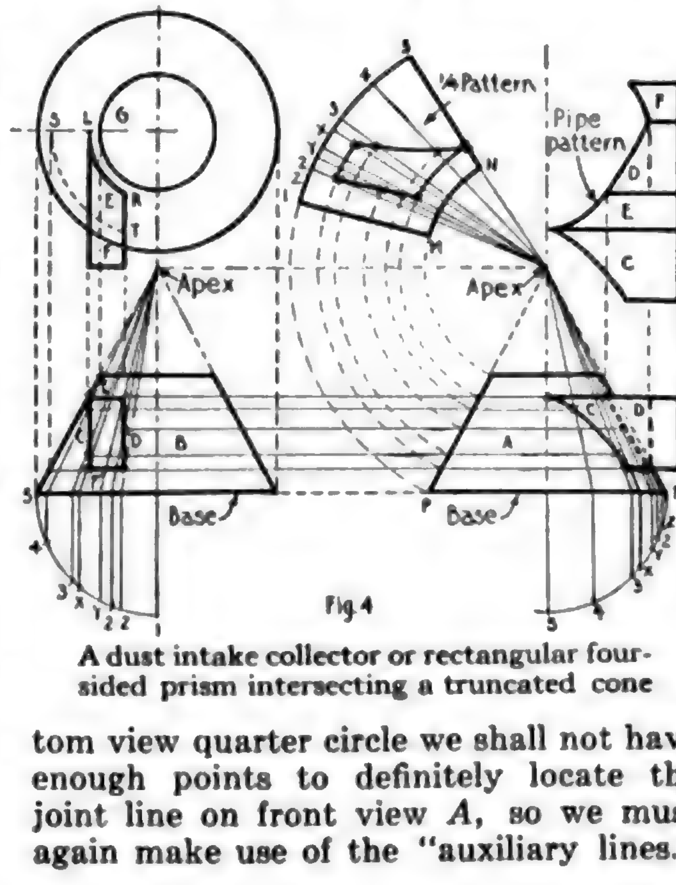


Developing a pattern for an egg tester which is a truncated cone and round pipe

the line apex-1 to get the true lengths. Do the same with the V-shaped opening at the bottom. Sixth, draw the top and bottom pattern arcs, *N-M* and 1-9, getting the correct length by transferring the spaces from the bottom view circle. Seventh, from the numbered spaces on the pattern arc, draw lines to the apex. Eighth, take the true length points on line apex-1 and swing them over the pattern until they cross the same numbered line coming up from the pattern arc, making crosses. Connect these crosses with a freehand curve. Ninth, to get the pattern for the V-shaped opening, get the true height by projecting straight across to the line apex-1, then swing the line over to radial pattern line, 5. To get the true width we must make use of "auxiliary points," as we have done once or twice before. On the front view project lines straight to the bottom view circle (points marked X). With your dividers take the distance on the circle from point 4-X and lay off on the pattern arc as shown in the drawing. Do the same for the other distance, 6-X, connect the three points and the one-half pattern will be complete.

The illustration (Fig. 4) shows the development of patterns for a "Dust collector Intake." The technical description of this problem is "Rectangular four-sided Prism Intersecting a Truncated Cone off Center."

The steps in the development of the pattern are as follows: First, draw front view, *A*; the joint line cannot be drawn until the points are projected across from the side view, *B*. In this problem the joint line is absolutely necessary and is obtained by drawing the bottom circle on both front *A* and side *B* views (as only one-quarter pattern is needed, only one-quarter circle is drawn). Second, space and number each bottom view quarter circle as in the preceding problems. Be very careful to number these correctly. Notice that 1 is at the right on front view *A*, but in the side view *B* it is in the exact center. Third, from these numbered points draw lines straight up to the base line, then straight to the apex. Fourth, on side view *B* where the lines to the apex cross the end view of the rectangular pipe make marks as in the drawing and draw lines across to the front view, *A*. Where they intersect the same numbered lines coming up from the bottom make a cross. It will be noticed that if we use only the regular numbered lines coming up from the bot-



A dust intake collector or rectangular four-sided prism intersecting a truncated cone

tom view quarter circle we shall not have enough points to definitely locate the joint line on front view *A*, so we must again make use of the "auxiliary lines."

On the side view *B* draw a line from the apex through the lower left-hand corner of the rectangular pipe until it strikes the base line, then drop it straight down to the bottom view quarter circle, mark *X*. Do the same with the upper right-hand corner and the lower right-hand corner, marking them respectively *Y* and *Z*. Now transfer with the dividers from the side view *B* bottom quarter circle to the front view *A* quarter circle the points *X*, *Y*, *Z*, getting the correct distance from points 2 and 3. From *X*, *Y*, and *Z* on the front view *A* draw lines straight up to the base line, then to the apex. Now draw the lines over from the side view to the front and make crosses just as you did with the regular numbered lines. Connect the crosses and you will have the complete joint line. The dotted part of the joint line is drawn dotted because it is invisible, as it is back of the pipe.

Now that we have the joint line we can proceed with the development of the cone pattern. It is only necessary to develop one-quarter because the important part is the hole and by marking off the pattern four times we can get the full pattern. This also saves metal and bulkiness of patterns.

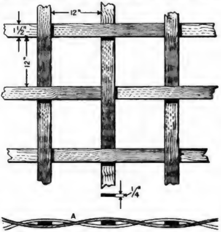
In the usual manner draw the top and bottom pattern arcs 1-5 and *M-N*, getting the correct length as usual by getting the spaces from the numbered points on the bottom view circle. Be sure and include the "auxiliary points." Then from the points where the lines we used to get the joint line cross the line apex-*P*, draw circles around to the pattern until they cross the same numbered or lettered lines. Where they intersect make crosses, then connect these with curves and the one-quarter pattern will be complete.

Now we have to get the pattern for the rectangular pipe. Notice that we already have the correct pattern for the two long sides of the pipe on the front view *A*. The front side is marked *C* and the back is marked *D*. Transfer the size and shape of *C* to the pattern, using the line *H-K* as a base line, getting the correct lengths from the end view of the pipe on view *B*. We must next get the pattern for the top of the pipe. This is done by the use of the top view *G*. Project two lines upwards from the rectangular pipe to points *L* and *R* on the top view, then draw the arc *L-R*. From the front view *A* get the correct length of the pipe and set it off on the top view *G*. This will give us the pattern for the top of the pipe *E*. Place this with *C* on the pipe pattern, next transfer the side *D* from the front view. To get the pattern *F* for the bottom of the rectangular pipe: On the side view *B* draw a line from the *F* to the line apex-5. Then up to point *S* on the top view. Then draw the circle *S-T* as indicated and you will have the pattern for the bottom *F*. Place this next to *D* and the pipe pattern is complete.

(To be continued)

Making a Lattice Trellis for Roses and Vines

A GOOD trellis for roses and vines may be made as follows: Procure as many 1½-in. by ¼-in. strips of wood as there are feet to the width and of the right length, and also as many for every foot



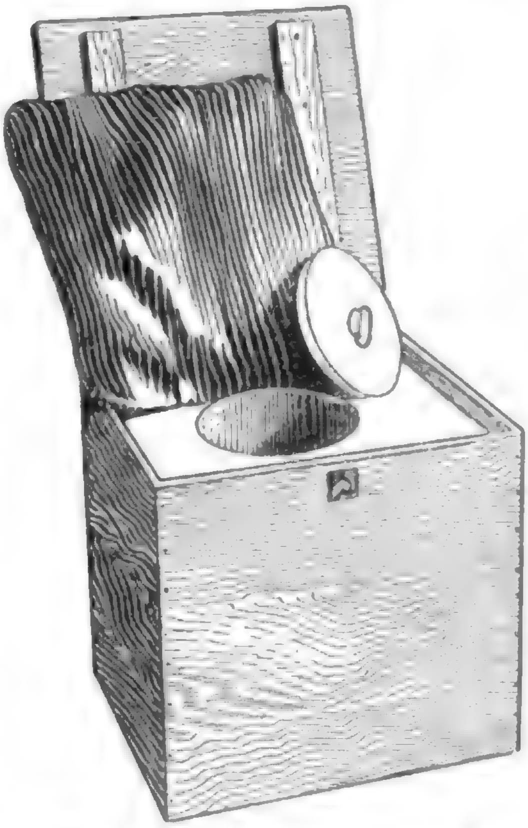
The strips of wood are interlaced in the construction of this trellis for roses

in length and proceed as follows. First lay out marks 12 in. apart on the strip to be used as a base, then tack the pieces that are to be used upright to these, each alternating piece on the other side from that nailed last, then interlace the cross pieces in these lengths as in weaving. The trellis will then have the appearance as shown at *A*. This lacing of the strips makes the trellis quite substantial.—LOUIS M. WAHRER.

How to Make an Efficient and Inexpensive Fireless Cooker

THE materials needed are a box, or some other outside container, some good insulating material, *B*, a kettle for holding the food, a container for the lining of the nest in which the kettle is to be placed, and a cushion or pad of insulating material for the cover on top of the kettle, and a cover, *G*.

For the outside container a tightly built wooden box as illustrated is the most satisfactory. The box should have a hinged cover, and at the front a hook and staple to hold the cover down. A window fastener answers the purpose well. The size of the box should be large enough to allow for about 4 in. of packing material all around the nest in which the kettle is set.

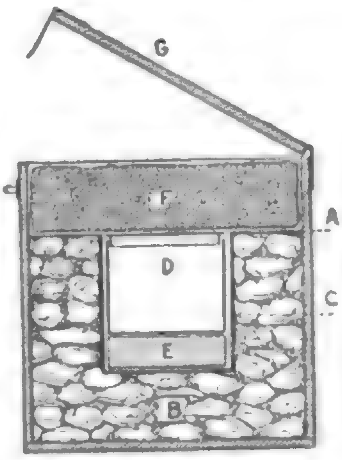


The outside container may be any box of a convenient size

The kettles used for cooking should be durable and free from seams or crevices, which are hard to clean. They should have vertical sides and the covers should be as flat as possible and provided with a deep rim fitting well down into the kettle to retain the steam. The size of the kettle should be determined by the quantity of food to be cooked. Small amounts of food cannot be cooked satisfactorily in large kettles, and it is therefore an advantage to have a cooker with compartments of two or more different sizes. Kettles holding about 6 quarts are of convenient size for general use. Tinned iron kettles should not be used in a fireless cooker, for, although cheap, they are apt to rust from the confined moisture. Enameled kettles are satisfactory, especially if the covers are of the same material. Aluminum vessels may be purchased in shapes which make them especially well adapted for use in fireless cookers and, like enameled ware, they do not rust.

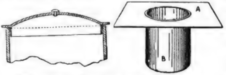
The container for the cooking vessel, or the lining for the nest in which it is to be put, should be cylindrical in shape and deep enough to hold the cooking kettle. It should fit as snugly as possible to the cooking vessel, but at the same time should allow the latter to be slipped in and out freely. If the cylinder is too large the air space between it and the kettle will tend to cool the food. For making this container a galvanized iron or other metal bucket, *B*, may be used or, better still, a tinsmith can make a lining of galvanized iron or zinc which can be provided with a rim, *A*, shown on following page, to cover the packing material.

For the packing and insulating material a variety of substances may be used. Asbestos and mineral wool are doubtless the best, and have the additional advantage that they do not burn. Ground cork or the packing from Malaga grapes, hay, excelsior, Spanish moss, wool, and crumpled paper may also be used satisfactorily. Of the inexpensive materials that can be obtained easily, crumpled paper is probably the most satisfactory, since it is clean and odorless, and, if properly packed, will hold the heat better than many of the others. To pack the container with paper, crush single sheets of newspaper in the hands and pack a layer at least 4 in. deep over the bottom of the outside of the container, tamping it in or pounding it with a heavy club. Stand the container for the cooking vessel, or the lining for the nest, in the center of this layer and pack in



Section through cooker showing insulation

more papers about it as solidly as possible. Whatever packing material is used, it should come to the top of the container for the kettle, and the box should lack about 4 in. of being full. A cushion or pad must be provided to fit completely the space be-



The cover with a deep rim and the container for the cooking vessel within the box

tween the top of the packing and the cover of the box after the kettles are put in place. This should be made of heavy goods, such as denim and stuffed with cotton, crumpled paper or excelsior. Hay may be used, but it is somewhat odorous.

The classes of food best adapted to the cooker are cereals, soups, meats, vegetables, dried fruits, steamed breads and puddings. When different foods are cooked together in the fireless cooker they must be such as to require the same amount of cooking, since the cooker cannot be opened to take the food out without allowing a large amount of heat to escape. It would not do to put foods which need about 1½ hours to cook in a cooker with, say, a piece of meat that requires several hours' cooking.

A Driver for Holding a Screw While Turning It

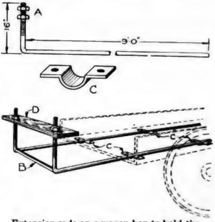
TAKE a round piece of wood, something like a lead pencil, of the required length, run a fine saw lengthwise through the end of it; then take a discarded clock spring, cut two pieces of equal lengths and insert them in the saw with the curves out. Wind it securely, pinch the ends together, insert them in the slot of a screw and you can hold it at any angle. If a watch spring is used and the ends made keen enough the device can be used to drive very small screws.—E. L. GRIFFITH.

Spring on end of stick to start screws

Extension Holder for Hauling Long Stock on Express Wagon

THE holder is made of two bars, each 9 ft. long and ¾ in. in diameter. They are bent at right angles on one end to make an upright 16 in. high. These pieces are joined together with another piece of the same stock welded in as at *B*. The length of this piece will be regulated by the width of the express wagon box on the inside.

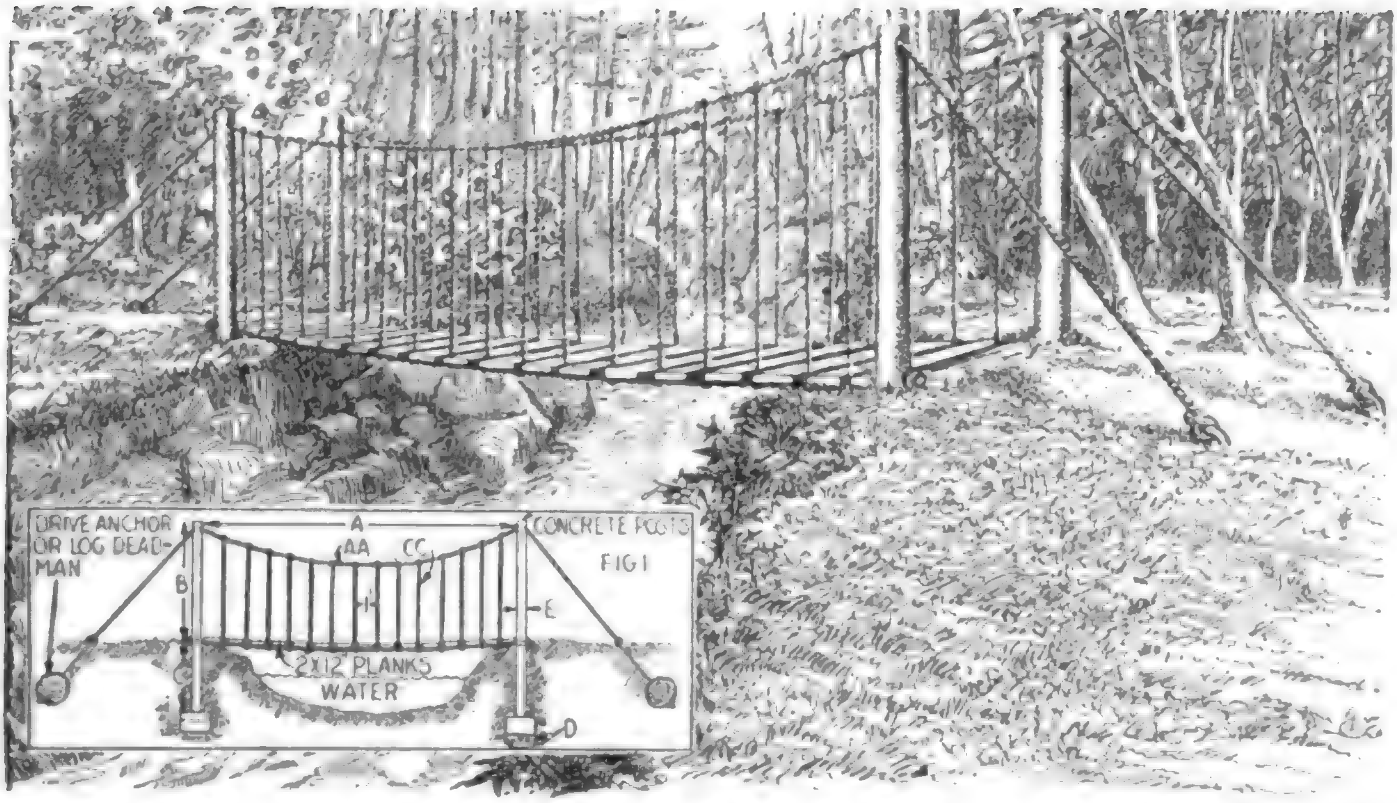
The bars are held in place inside of the wagon box with four pieces of metal shaped as shown at *C* and made from stock 1 in. wide and ¼ in. thick. These are bolted to the upper surface of the bottom of the wagon box.



Extension rods on a wagon box to hold the pipe ends and keep them from lashing about

The upper ends of these rods are threaded for almost their entire length and fitted loosely with two nuts. A crossbar, *D*, made of stock 2 in. wide and ¼ in. thick is drilled to fit on the rod ends between the nuts, *A*.

In hauling long rods, pipe or lumber the holder is slipped in place in the clips, *C*, and the material loaded on it. The crossbar, *D*, is then put on and the nuts adjusted to hold the load. This prevents the long ends of the material extending from the rear of the box from lashing about and makes it possible for the load to be placed against the front end of the wagon box, where it will not extend over and strike the horse. This device is very serviceable.—JAMES E. NOBLE.

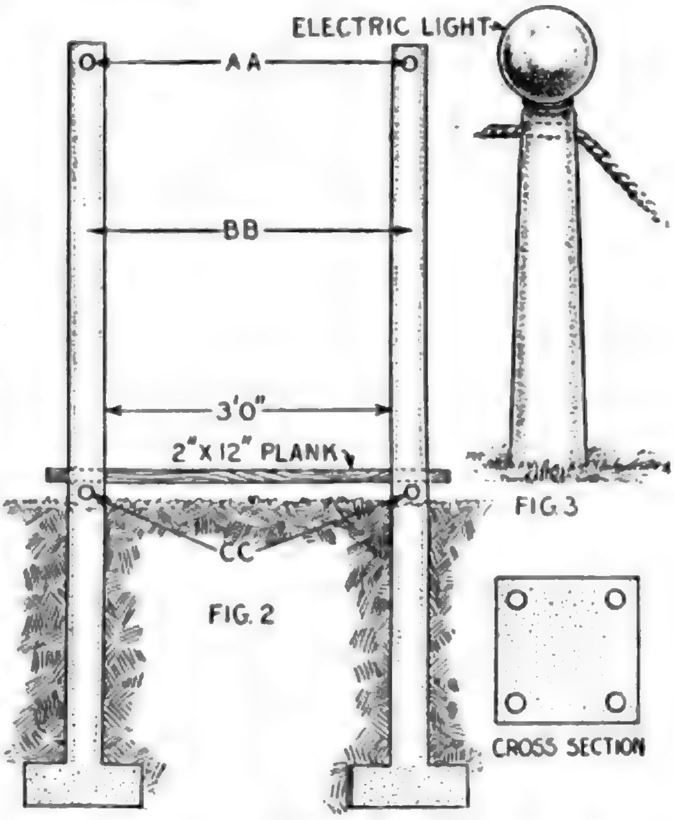


A Rope Suspension Bridge for a Garden

SUSPENSION bridges present a very artistic structure for spanning small streams or a brook on the grounds or in a park. The illustration gives the details of such a bridge and tables of proportions for construction of the different lengths.

The concrete posts which hold the upper cord of the bridge are built and reinforced as shown in Fig. 1. The suspension cable is secured to a drive anchor, expanding anchor or dead man and then run across the ravine and secured on the opposite side in the same manner. Both suspension cables should be the same length and have the same amount of slack or sag. The lower cord is drawn as taut as possible and then hung perfectly level by the supporting vertical cables, which should be spaced about 1 ft. apart. When all vertical cables are secured to both the upper and lower cords the latter is drawn up again and secured at each end.

Planks are laid across the lower cord and held in place by driving large staples over the rope and into the bottom of the plank. The tables should be studied closely. Table 2 gives the size of the post, length above and below ground and size of spread footing, while Table 3 gives the size of the ropes to use for the various lengths of the span. In the last column of this table is given the size of the bottom cord of round iron bar, which is used in place of manila rope, and in Table 4 is given the number and size of the bars necessary to reinforce the columns shown or mentioned in Table 2.



A cross section of the completed bridge and the detail of the anchor post and its base

The illustration, Fig. 2, gives a cross-section of the completed bridge, while Fig. 3 shows a little more detail of the

anchor post. Of course the builder can exercise his own ingenuity in designing the posts and in the method of connecting the upper and lower cords, but two half-hitches of the vertical cables around both the upper and lower cords will answer the purpose. Care must be taken to see that

A	B	C	D	E
6 ft.	5 ft.	4 ft.	14 in.	7 by 7 in.
8 "	6 "	4½ "	14 "	8 " 8 "
10 "	7 "	4½ "	18 "	8 " 8 "
15 "	8 "	5 "	20 "	10 " 10 "
20 "	10 "	6 "	24 "	12 " 12 "

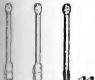
A	AA	BB	CC Hemp	CC Iron
6 ft.	5/8 in. dia.	5/8 in. dia.	5/8 in. dia.	½ in. dia.
8 "	¾ " "	5/8 " "	5/8 " "	½ " "
10 "	1 " "	5/8 " "	¾ " "	5/8 " "
15 "	¼ " "	¾ " "	1 " "	¾ " "
20 "	1¼ " "	¾ " "	1 " "	¾ " "

Size of Post	Size of Rods	Number of Rods
7 by 7 in. by 9 ft.	3/8 in. dia.	4
8 " 8 " " 10½ "	3/8 " "	4
8 " 8 " " 11½ "	½ " "	6
10 " 10 " " 14 "	½ " "	8
12 " 12 " " 16 "	5/8 " "	8

the cables are kept free from chafing and all ropes and cables should be well soaked in good hot pitch before the work is finished or decay will ruin the bridge in a short time.—George M. Petersen.

Starting a Very Small Screw with Adhesive Tape

Being without the necessary tweezers to handle a very small screw I took a match stick and [illegible]

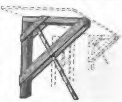


Adhesive tape on match to start screws

[illegible] was necessary to use [illegible] M Kane.

A Scaffold for Holding in Place with a Pole

This device I saw in use by some country plasterers who were re-plastering the very high end of a farm house. Each one was made of two pieces of 3 by 4-in. stock, about 3 ft. long for the upper part, and 4 ft. for the other side of the angle. To make it, nail the two pieces together to form an angle. Then prepare two pieces of 1-in. white pine board, and nail one end to the outer end of the horizontal arm, and the other end to the bottom of the vertical part. Also fasten the two pieces at the top of the angle, as shown in the illustration. The long pole is used to push the bracket up against the side of the house into position, at any desired height, and according to the length of the pole. The double braces keep the scaffold from turning side-ways on the pole when placed on the side of the house.



Portable scaffold brackets for work on house exteriors

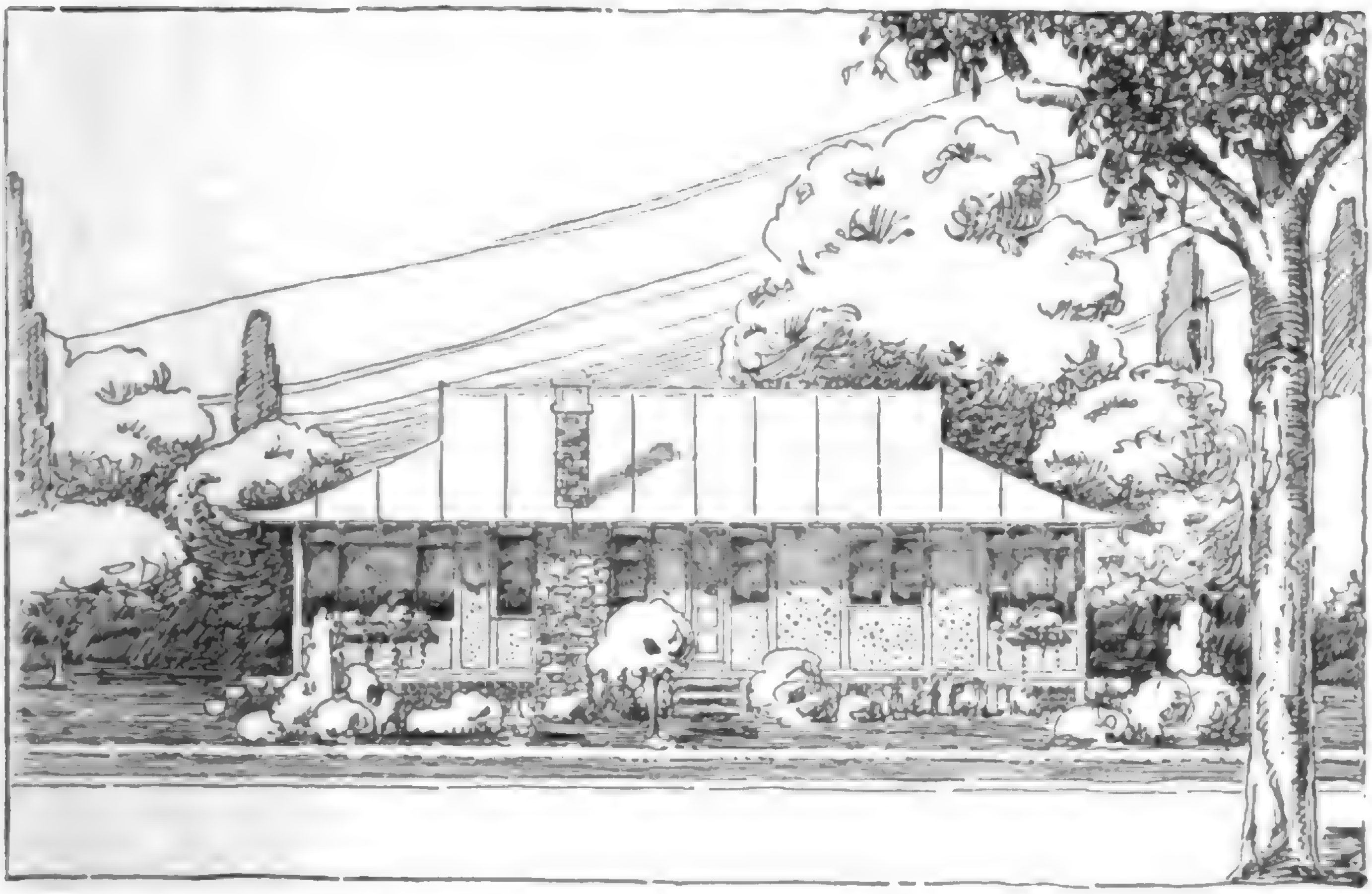
Such a scaffold will hold almost any weight, for the more the weight the tighter it will hold, though the pole should have firm footing, not too soft, but not hard enough to cause slipping. Two of the brackets will do ordinary jobs, but as many brackets may be used as may be necessary, of course. This scaffolding has many features to commend it to workmen.—A. A. Kelly.

Holding Photographic Plates from Tray Bottom

The developing of plates in a flat tray in a darkroom is often a very bothersome task, because the plates stick to the bottom of the tray when one wishes to remove them for examination and at the end of the development period. An excellent plan to avoid this trouble is to stretch a rubber band loosely over and round each end of the tray through the developer and then lay the plates on the sagging rubber bands, which will prevent the plates from sticking and improve the general results.

A Convenient Summer Cottage

By C. M. Tomlinson



THE cottage proper is 18 by 24 ft.; an 8 ft. screened-in porch at each end makes the total length 40 ft. The low cost is made possible by choosing the dimensions so that stock sizes and lengths of lumber, doors, sashes, etc., may be used. With a little care in buying there is little waste, and in many cases no cutting is required.

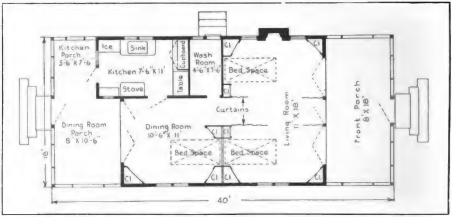
To secure the maximum of accommodations, every device known to the modern builder is used. The floor is divided near the middle by a partition, making a living room at one end and a dining-room and wash room at the other. A fireplace on one side of the living room assures comfort on cold mornings, chilly days, and during the cool weather of late fall or early spring. Recesses 12 in. deep in the partition provide space for three swinging beds which are screened off by partitions during the day. Occupants of each of the beds in the living room secure privacy by dropping curtains from the ceiling; a passage way through the center of the room is left at all times, and one-half of the living room may be occupied by those sitting up late when the other half is used as a bedroom. The spaces in the partition not required for the beds are utilized for closets.

The doors of the porches fold back so that by opening them wide the area of the living room and dining-room are really made to include the additional space. The wash and dressing room has an entrance from the outside so that bathers need not track through the rest of the building to reach it.

Bookcases are built into the walls between windows, and the walls of the wash room and kitchen likewise utilized for the appropriate built-in furnishings. Trunks may be placed in the corners behind the doors and screened off.

The cottage is so planned that it may be built in sections, the structure making a harmonious whole at each stage. If desired the wash and dressing room may be made a little larger and used for a maid's or chauffeur's room. A second story may be added for about $200.

By making the greatest possible use of the cottage, the following accommoda-



The floor is divided near the center with a partition, making a living room at one end and a dining-room and wash room at the other and a fireplace in one side of the living room

tions are provided by the ingenious arrangement:

By day: Living room 11 by 18 ft., with fireplace, or with front doors open to include porch, 18 by 19 ft. Dining-room 10 by 11 ft., or with doors open to include porch, 10 by 19 ft. Kitchen 7 by 11 ft., with kitchen porch 6 by 7 ft. Wash and dressing room 4 by 7 ft. Front porch 8 by 18 ft. Rear porch 8 by 10 ft.

By night: A front porch 8 by 18 ft., which by the use of screens may be turned into a sleeping porch. Rear porch almost as large capable of same use. Two front bedrooms each 7 by 11 ft. One rear bedroom 10 by 11 ft. If the sleeping porches are utilized and a cot placed in each bedroom, sleeping accommodations for a dozen people may be provided.

How to Make an Automobile Spring Leaf-Separator

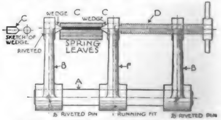
THE body springs of an automobile should be periodically lubricated. This will result in greater comfort to the occupants as well as in quieter riding.

A common practice on the part of the average driver is to separate the leaves of the springs with the aid of a hammer and chisel or a screw-driver. Procedure such as this, however, is extremely detrimental to the well-being of the springs, the constant hammering causing unnecessary strain on the leaves.

The accompanying sketches illustrate the construction of a simple appliance which was built from discarded automobile parts such as may be found in the junk pile of any average garage repair shop. It consists essentially of a rod, *A*, to both ends of which are riveted levers, *B*, (discarded brake levers). The pointed plugs, *C*, are riveted into the upper end of one lever, while screw *D* passes through the upper end of the other lever.

A third lever, *F*, placed between the levers, *B*, is bored out at its hub to permit its sliding smoothly over the shaft, *A*. In addition its upper end is provided with a plug, *C*, similar to that placed in the other lever. The plug in the lever, *F*, however, is bored out at one end to receive the pressure from the screw, *D*.

The operation of the appliance is ex-

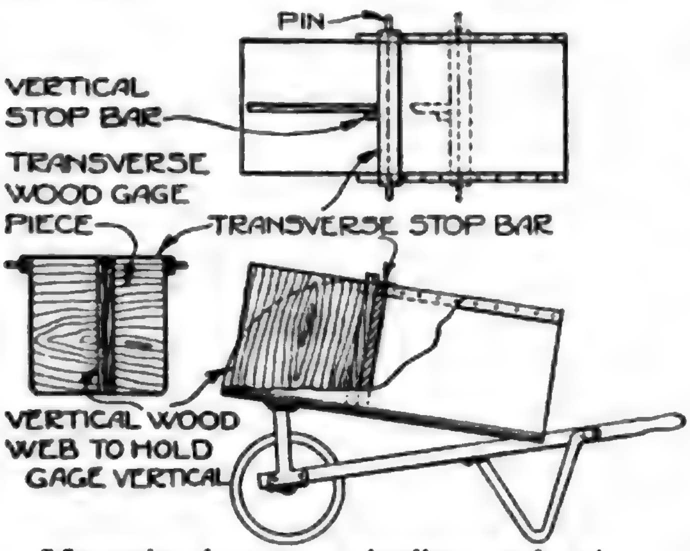


Levers mounted on a bar carrying cone points for separating the leaves of a spring

tremely simple. Turning the screw, *D*, forces the plugs, *C*, towards one another; consequently when they are placed between two leaves of the spring, a few turns of the screw will readily separate them.—ADOLPH KLEIN.

Self-Measuring Wheelbarrow for Concrete Aggregates

A SELF-MEASURING wheelbarrow designed to promote convenience, rapidity and accuracy in handling concrete aggregate, is shown in the accompanying sketch. It consists of an ordinary



Measuring box on a wheelbarrow for obtaining the proper amounts of concrete

steel body wheelbarrow pan with a transverse wood gage of the same shape as the inside of the pan. This gage is moved up and down in the pan, according to the amount of concrete to be carried, the latter being measured between the gage-board and the rear end of the pan. The gage-board may be set at any desired position by means of a transverse bar across the top of the pan. The bar is held in place by two pins inserted through any one of a series of small holes along the sides of the pan at the top. The gage-board is held against the transverse bar by a vertical wooden piece nailed to a web fitted to the gage-board at right angles to it at the open end. When the concrete is to be dumped, the gage-board is removed.

Applying Grease to Working Gloves to Make Them Wear

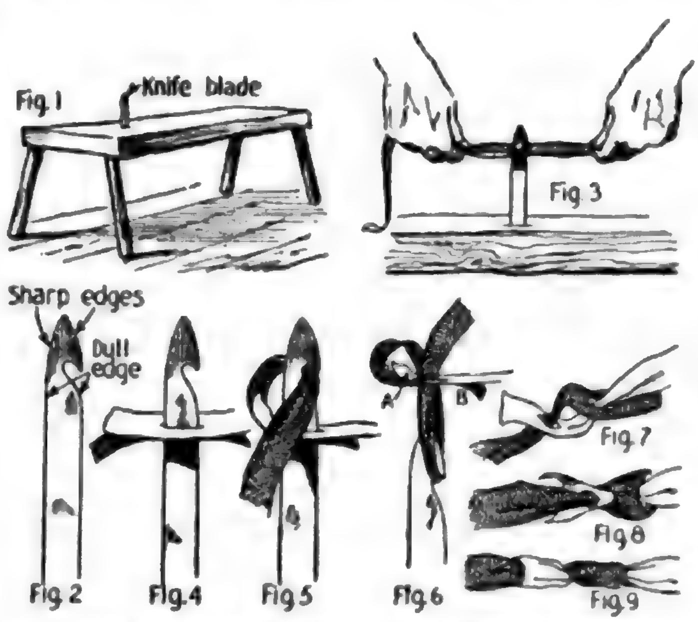
A FRIEND of mine who does heavy work of various kinds which requires gloves, and heavy leather gloves at that, advises me that gloves can be made to wear almost like iron by applying axle grease sparingly and being very careful not to get it on the cloth stitching, as the axle grease may disintegrate it somewhat.

Making a Photographic Timer out of an Ordinary Watch

A SIMPLE adaptation of an ordinary watch to use as a timer of value in long photographic exposures by photo-engravers and printers, or for use in timing action of developer, can be made by painting a narrow line on the under side of the edge of the watch crystal. Then, by revolving the crystal till the mark coincides with the minute hand, it is easy to register the exact time that exposure began.—GEORGE PARKE.

Joining the Ends of Carpet Rags Without Sewing

AN old backwoodsman used this method of joining carpet rags end to end, without sewing the strips together. He mounted a strong knife blade, previously shaped like a crochet needle, as shown in Fig. 1, on the bench he used for a seat. The point and upper edges of the knife were sharpened as shown in Fig. 2. Taking the ends of two strips, he pressed them down over the blade, Fig. 3, until they were as shown in Fig. 4. One end was looped under the eye of the needle, Fig. 5, and while holding the ends *A* and

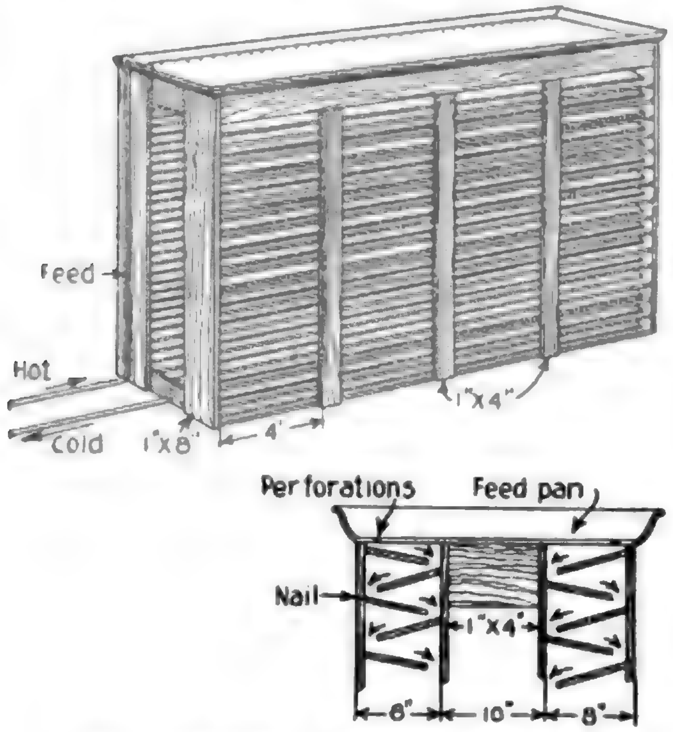


Knife blade arrangement for fastening the ends of carpet rags without stitching

B, Fig. 6, they were drawn upward. The resultant knot, Fig. 7, can be shaped as in Fig. 8 and drawn tightly as in Fig. 9. Other pieces are attached in the same manner to make a continuous line for the weaving.—JAMES M. KANE.

An Inexpensive and Effective Water Cooler

IN the usual gas-engine installation the water is circulated through a large tank where it is cooled by radiation. Ordinarily this process answers every purpose,



Numerous boards arranged in a rack to spread the water for cooling it in the air

but in the case of small ice plants, now becoming rather common, a much greater cooling effect is desired. The accompanying illustration shows a simple and yet very effective cooler in which the cooling principle utilized is that of evaporation. The apparatus is easy to construct and the cost is low, as it is made almost entirely of wood.

Briefly stated, the method consists in emptying the heated water into a long, narrow galvanized-iron pan, perforated along each side with a series of small holes. The water drips in fine streams through these and falls on a board inclined toward one side, which becomes thoroughly and uniformly wet on its upper side. The water then trickles off the lower edge onto a similar board inclined in the opposite direction. The wetting action is here repeated and the water falls onto a third board, and so on for twenty or thirty drops, according to the cooling capacity desired. It is finally caught by another galvanized iron pan at the bottom, from which it is pumped for use again.

Aside from its cheapness and ease of construction, the wood has a distinct advantage over metal in that the water spreads out in a uniform layer, whereas on metal the tendency of the water is to trickle down in small irregular streams.

The cross-sectional diagram clearly shows the relation of the sloping boards and the two pans, while an idea of the general appearance will be gained from the perspective view. When used on the shady side of a building, in a region where the humidity is low, the evaporation is rapid and the cooling effect really remarkable.—JOHN D. ADAMS.

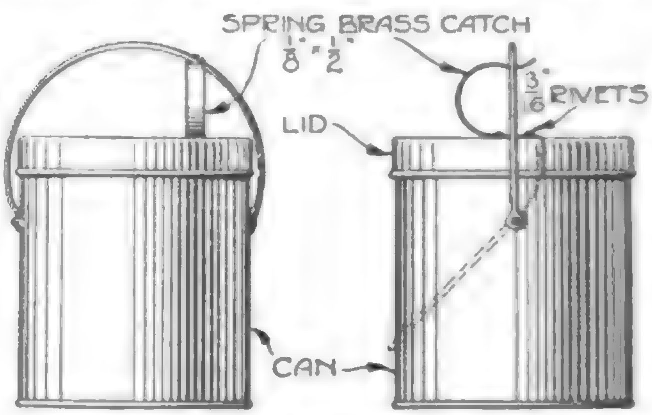
Renewing a Worn Artist's Brush by Repointing It

THE points of sable or camel's-hair brushes such as are used by artists rapidly wear away, thus rendering them practically worthless.

An apparently worthless brush may be restored by dipping the bristles in glue, pointing it as well as possible at the time. When thoroughly hardened the brush is repointed on a sharpening stone the same as if it were a steel point. It can be done even more rapidly by holding against a slowly revolving emery wheel. The glue is then dissolved by immersing in hot water.—L. B. ROBBINS.

A Spring Lock for the Cover of a Garbage Can

THIS lock is for attaching to an ordinary garbage can, built like a pail having a bail. The spring catch, as illustrated, is riveted to the can cover,



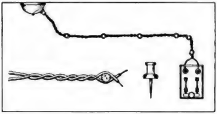
Spring catch on a garbage can cover to hold it in place with bail in upright position

the upper part snapping under the bail when it is in an upright position for carrying.—P. P. AVERY.

The Amateur Electrician And Wireless Operator

A Cleat for Holding Temporary Electric Wires

THE accompany illustration shows a simple means for holding temporary wiring in place. The cleat is nothing



Glass push pins used as temporary cleats for electric light and telephone wires

more than the handy little glass push pin that can be purchased at any stationery store. It is very easy to attach, does not mar the surface of the wall and, being glass, is of course an insulator. The pin is first forced into the wall and then the double conductor cord is slipped over the head.—EDWARD R. CULLEN.

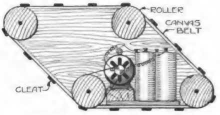
An Electrically Driven Toy Tank That Goes "over the Top"

THIS caterpillar tank will crawl along the ground, go "over the top" of miniature trenches, plunge through wire entanglements, and push aside or climb anything that is in its path. It is a small model of the latest machines that the British Army has been using so successfully.

Two side pieces cut from ¼-in. pine wood in the shape of a diamond 12 in. long, constitute the frame. At each corner of the frame a roller is placed. These should be 6 in. long and 2 in. in diameter. A small nail driven through the frame corner and into the center of the end of the roller makes a shaft that is good enough for the purpose.

Now for the construction of the interior. Between the bottom edge of the framepieces a shelf should be nailed and upon this fastened the batteries and an electric motor, which will furnish the power. These should be secured with screws so that in case the tank tips over they will not be jarred out of place. Belt the pulley of the motor to the nearest roller and wire the batteries to the motor.

Over the four rollers a canvas or leather belt is laced snugly. To keep from slipping this belt should have several narrow wood cleats nailed upon it. A small door in the frame makes a convenient place to get to the motor in order to turn on the power, etc. It is evident that when the current turns the motor that the rollers will revolve, and, as the belt grips the ground securely because of the cleats it



A toy tank made of wood and inclosing a motor and batteries for the power plant

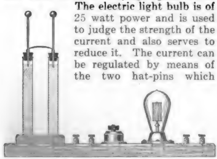
carries, the caterpillar tank will crawl slowly along. The motor is of the small, toy size; from 4 to 6 in. high being plenty powerful enough.—F. E. BRIMMER.

Durable Terminals for Electrical Conductor Cords

THE terminals of flexible conductor cords often become frayed with use, a condition which results in poor connections and short circuits. A good terminal is made as follows: Peel back the insulation on the cord until a clean surface is obtained; then cut it off squarely and bend the end into a symmetrical loop. Dip the loop first into soldering flux and then into molten solder, holding it until the solder "takes." This forms a solid terminal which can be screwed down tight without injury and will prove satisfactory.—THOS. A. REYNOLDS.

Shocking Device That Works on the Commercial Current

AN electrical shocking device which gives an even, soothing effect to the nerves is preferable to those which produce slow, intermittent discharges. An apparatus for producing the soothing current is quite easily made. The source of current is an 110 volt A.C. which is reduced by resistance. The main source of resistance is the weak solution of salt and water in the two upright glass tubes. The electric light bulb is of 25 watt power and is used to judge the strength of the current and also serves to reduce it. The current can be regulated by means of the two hat-pins which project through the stoppers of the tubes. One set of binding posts is for the main circuit, the other is used for the transmission of the current into the body. A set of handles made from the carbons of old dry cells are used for hand-grips.



Resistance in two tubes to reduce alternating current for a shocking machine

To regulate the shocker, see that the switch, shown in the center of the illustration, is turned off. Then short-circuit the hand-grips and turn on the switch Push down the hat-pins in the tubes until the wires in the bulb are reddened. Note the amount of water that is between the connection points of each tube. Add the two amounts and increase the distance between them about 8 in. A very low current should be flowing through the apparatus and it is now quite safe to grip the handles. The current can now be varied to suit.—JOHN C. JACK.

Locating and Repairing Short-Circuited Armature Coils

TO locate a short-circuited armature coil, pass a current from a battery of dry cells, or a storage battery, through the armature, using the brushes of the machine for terminals. Using a low-reading voltmeter, touch its lead wires to one pair after another of the adjacent commutator segments. A zero deflection of the voltmeter needle indicates a short-circuited armature coil.

It will be seen, at periodic intervals in passing around the commutator, that the meter deflection reverses, and that just preceding this transition point the value is less than normal deflection. This merely indicates the passage from one pole to another on the winding. Thus, for instance, on a four-pole armature, there will occur four such reversals. Switching of the voltmeter leads will cause the meter to register in the right direction.

If a "short" is found, clean out the spaces between commutator segments, to be sure that no mental dust is responsible for the trouble. If this trial fails, carefully lift out the coil connected to the bars to which the short-circuit was traced, and repair any insulation breaks.

If a winding is broken, the break may be located by connecting a battery through an ammeter to two metal strips, held apart by a piece of wood, at such a distance that they will touch adjacent bars on the commutator. Holding this device against the commutator surfaces turn the armature slowly by hand. A reduced or zero deflection of the meter indicates a broken or open-circuited winding. The only thing to do in this case, is to lift out the damaged coil, solder the ends together, re-insulate the break, and place the wire back in its proper slots on the armature.—PETER J. M. CLUTE.

Electrical Devices and How They Work

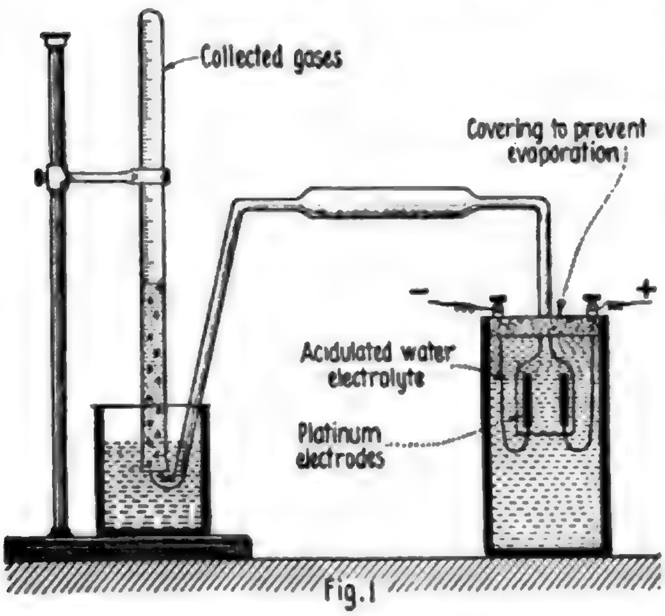
VI.—Electrical metering instruments

By Peter J. M. Clute, B. E.

ELECTRICITY is manifested to us only through certain effects which it produces. These effects may be mostly classified under chemical, thermal, magnetic, and static effects.

Chemical effect is manifested by the decomposition of a solution when a current of electricity passes through it.

Thermal effect is produced by the passage of an electric current through a conductor of appreciable resistance.



A gas voltameter consisting of two platinum electrodes immersed in acidulated water

Magnetic effect results from an electric current in a conductor when brought into a magnetic field, the field being produced by a magnetic or other electric currents.

Static effect is the attraction or repulsion existing between highly electrified bodies.

These effects all occur in perfect accordance with definitely fixed natural laws, and as a consequence they have been utilized in the design of various instruments for the measurement of electrical qualities.

Electrolytic meters, depending on the chemical effect of the electric current, do not indicate directly in amperes the current flowing, but are used to determine the quantity of current which passes in a definite period of time. Thus, they should be termed coulomb, or ampere-hour, meters. In Fig. 1 is shown the gas voltameter or electrolytic meter. The gas voltameter consists of two platinum electrodes immersed in acidulated water, so arranged that all the evolved gas would be collected in a graduated cylinder. It can thus be demonstrated that the amount of gas is entirely independent of any consideration by the quantity of current flowing. By using solutions of different metals for electrolyte, it can be shown that the weight of metal deposited on the positive electrode is always proportional to the amount of current in the circuit.

The commercial electrolytic instrument depends on the principle that current passing through a volume of water decomposes it into its constituent gases, hydrogen and oxygen. This decomposition is directly in proportion to the current passing, one ampere-hour decomposing .338 gms. of water. The current flows through a volume of water contained in a properly graduated tube, the change in volume of water in a given time, indicated by the difference in levels, showing the amount of current which has passed.

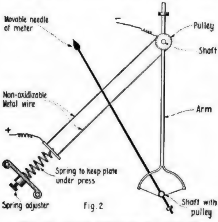
The commercial use of electrolytic meters is quite limited, and in most cases they have been superseded by direct-reading electro-magnetic type meters.

The thermal effect of electric current is utilized in some instruments to measure the current passing, by means of the expansion of a wire. The heating of a wire is proportional to the square of the current and the resistance of the wire, when a current is passed through it.

Hot-wire instruments are used to measure current or differences in potential by the heating effect of the current. Referring to Fig. 2, a long wire, of high resistance, non-oxidizable metal, has one end fastened to a plate, passes over a pulley and back to the plate. A spring attached to the plate keeps the wire stretched taut. When a current is passed through the wire, it heats and expands,

the increase in length causing the pulley to rotate, carrying the arm with it. This arm movement causes the silk fiber to rotate the shaft, which carries the needle.

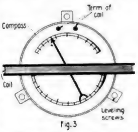
Hot-wire meters deflect in the same direction for currents in either direction and are equally accurate on direct and alternating current. They are not affected by stray magnetism and have the advantage that they can be calibrated on direct for use on alternating current. This type of instrument is not generally employed in practical work, but is valuable for measuring currents of high frequency, such as are used in wireless telegraphy.



Hot-wire meters deflect in the same direction for currents in either direction

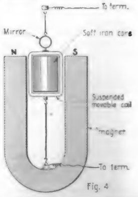
The simplest form of meter employing the electromagnetic effect is the galvanometer, an instrument for detecting small currents. In Fig. 3 is a so-called tangent galvanometer, the operating principle of which is as follows: If a coil of wire is placed in the plane of the magnetic meridian (*N* and *S* line), and a magnetic needle is suspended at its center, a current passing through the coil will deflect the needle away from the magnetic meridian by an angle whose tangent is proportional to the current strength.

The D'Arsonval galvanometer is a modification of the tangent galvanometer, with reversed positions of moving and fixed elements. In this instrument, there is a small solenoid oscillating under the directive force of a permanent magnet, instead of a suspended magnet moving under the directive force of a coil. Current which is lead to the coil through its suspension causes it to rotate about its axis, with a tendency to place itself at right angles to the lines of force. A pointer may be fastened to the coil to show the deflections, or a mirror may be used, from which a reflected light ray forms the pointer. In most forms of this instrument (see Fig. 4) a soft iron core is supported between the magnet poles from the rear, leaving a space between core and magnet, in which the coil swings. This tends to increase the magnetic field in which the coil rotates, giving a more sensitive deflection.



The simplest form of a tangent galvanometer

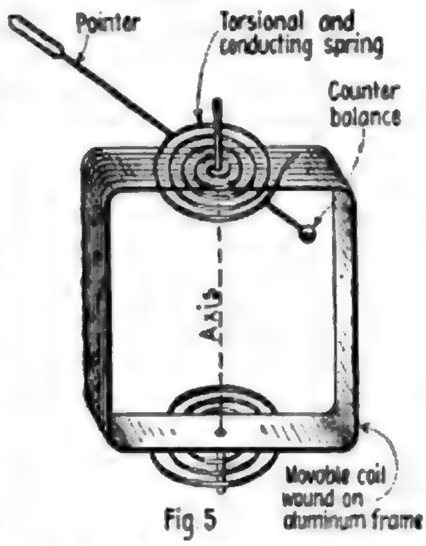
Galvanometers are generally used to indicate the presence and direction of electric currents rather than to ascertain their intensity. The D'Arsonval principle, however, can be applied to portable meters for the direct measurement of voltage and amperage. When used to measure potential or E. M. F. they are called voltmeters, and are graduated to read in volts; and when measuring current, they are called ammeters, and read the current in amperes. In Fig. 5 is shown the D'Arsonval principle as applied to instruments of this sort.



A soft iron core supported between permanent magnetic poles

In fundamental principles, ammeters and voltmeters are alike, inasmuch as the deflecting torque of the instrument is

proportional to the strength of the magnetic field multiplied by the current flowing in the movable coil. An ammeter, since it measures the current flowing in the conductor, must be placed in series in the circuit and hence its coil should have as low resistance as possible. On the other hand, a voltmeter, inasmuch as it measures the potential difference between two wires, should be placed across these wires, and, therefore, should have a high resistance so as to take but a small current. Since the voltmeter's resistance is fixed, the current through the meter will be proportional to the E.M.F. in volts, so that, like an ammeter, a voltmeter really operates in obedience to current variations.



Movable element in the D'Arsonval type

In the ammeter, the movable coil is composed of a few turns of larger wire than is used in the voltmeter. When designed for small capacity, the total current to be measured may be passed directly through the coil. For heavy currents, in excess of the ampere capacity of the wire or in excess of full-scale meter deflection, a portion of the current is shunted through a low resistance circuit called a shunt, which is paralleled in the circuit of the movable element. Thus, by using a suitable shunt, a current of any magnitude may be measured.

In the voltmeter, the moving element consists of many turns of fine wire in series with which there is a resistance. This resistance is such that, when maximum voltage is applied, the current through the movable coil is limited to the amount necessary to give full scale deflection.

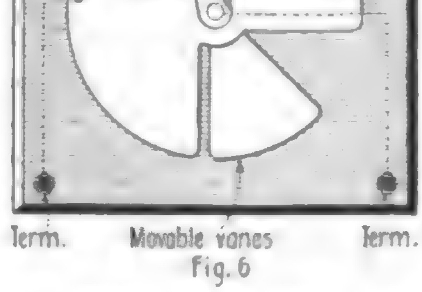
Electrometers are instruments depending upon the mutual attraction between opposite electrostatic charges. If a source of E.M.F. is connected to two metallic plates, they will take charges in proportion to their potential difference, and a certain electrostatic attraction results. If one of the plates is permitted to move, the electrostatic capacity of the system increases, thus increasing the amount of the charges and the force of attraction.

This principle is employed in the construction of electrostatic voltmeters, adapted for the measurement of high voltages. This meter is easily insulated, of simple construction, requires no internal resistance wire, it consumes no current on D.C. and practically none on A.C., its deflections are independent of the frequency, wave form, and stray magnetic fields, and it indicates equally well on direct and alternating current.

The electrostatic voltmeter, shown in Fig. 6, consists primarily of fixed and movable metallic vanes of relatively large surface, generally plane, but sometimes curved. The two terminals are connected, one to the fixed part and the other to the movable part, which has a pointer attached to give the deflections on a graduated scale. The type of electrostatic voltmeter shown is designed for potentials of 1,500 to 10,000 volts.

In addition to the above standard types of electrical meters, there is still quite a number of other instruments designed for special uses. These include:

The frequency meter, or indicator, used to determine the frequency or number of complete cycles per second of an alternating current.



The voltmeter consists of fixed and movable vanes

The wattmeter used for measuring directly in watts the power expended in a circuit. Wattmeters are of either the indicating or recording type.

Ohmmeters used to give directly the value, in ohms, of a resistance that is being measured.

The dynamometer, a moving coil meter, used for measuring currents,

E.M.F.'s, and power on both D.C. and A.C. circuits.

The permeability bridge, an apparatus designed for the determination of the magnetic densities of iron corresponding to given magnetizing forces.

The hysteresis meter used for measuring the hysteresis in sheet iron and steel.

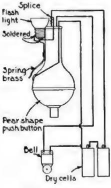
The Wheatstone, or slide-wire, bridge used for the accurate determination of resistance.

The above discussion includes the principal types of meters and instruments used in the testing of electrical apparatus. While there are other meters on the market, it will generally be found that they are simply modifications of one or the other of the above typical meters, or are designed for very special or limited use.

(To be continued)

A Combined Electric Night-Bell and Flash-Light

IN rigging up a bell for an invalid it was decided to add an extra wire and have a flash-light as well as a bell. The bell and light are independent of each other, although one of the bell wires is also used for the light and the same batteries work them both. The drawing shows clearly how to connect the wires.



A battery lamp on push button

A pear-shaped push button is used for the bell and connected in the usual way. The flash-light with its reflector is held in place by binding it with adhesive plaster. The switch consists of a piece of spring brass and a round head screw. After all the connections are made, the whole neck of the push button is wound with tape. Pushing the switch lights the light, pushing the button on the end of the push button rings the bell. Two cells of [illegible] battery will be sufficient to wor[illegible] the light or bell.—ALBERT E. J[illegible]

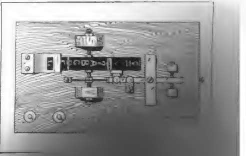
A Thimble Used as a Ferrule on a Tool Handle

AN old thimble makes an excellent ferrule for a small screwdriver handle or a similar tool. A notch is filed in the thimble end to admit the rectangular shank of the tool like a flat file. Round shanks may be fitted into a drilled hole or the thimble end cut off entirely for tools like an awl or chisel. The small indentations will hold firmly in the wood if the end is fitted snugly; however a prick punch or a small hole with a brad driven in will keep the thimble in place on the handle. The round end of the thimble makes a very neat fitting ferrule that is not obtainable in the ordinary kind.—JAMES M. KANE.

Thimble on wood handle

A Self-Translating Telegraph Line for Amateurs

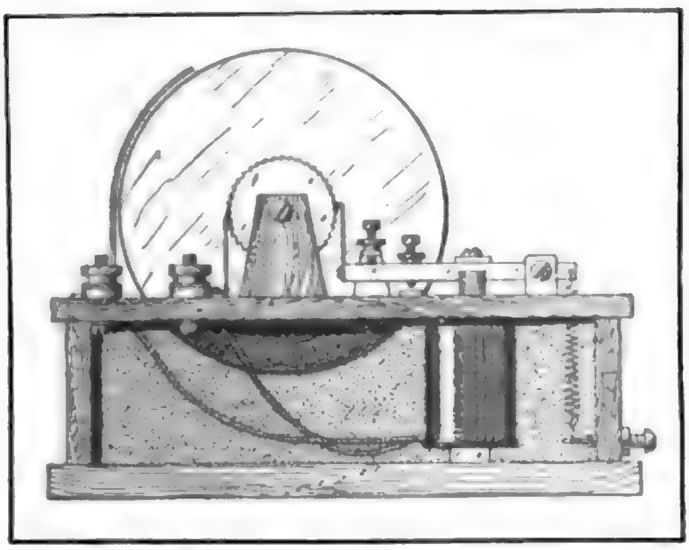
THOSE electrical experimenters who have possessed a private telegraph line know what fascination there is in communicating with a friend by this means and also know what a wonderful possibility of misunderstanding there is in such a device when the operators have only a speaking acquaintance with the



were it not for the difficulty of learning the code sufficiently to understand what comes over the wire. And it is to make possible a line which sends automatically and automatically translates its signals that the device illustrated herewith was developed.

The principle made use of involves the so-called "step by step" method of producing synchronous motions at separated points and makes use of the ordinary telegraph sounders and keys and the ordinary battery.

Reference to the drawings will show that there is provided a flat wooden wheel having around its periphery forty divisions to correspond to the forty necessary characters of the alphabet including the numerals and the necessary punctuation marks. To the shaft of this wheel is rigidly attached a thin metal rachet wheel,



The wood wheel with a thin ratchet wheel attached to turn it as the sounder works

such as can be purchased at the store of any gear supply dealer, having forty teeth. This shaft is mounted to rotate rather stiffly between bearings formed by screws having holes drilled in the tips, the shaft being pointed at either end to bear in the holes. The bearing screws are mounted in wood pedestals, as suggested by the drawings, and the whole mounted on a suitable base. A telegraph sounder, or any similar arrangement of magnets and lever, is arranged under the wheel and has mounted at the end of the lever a thin piece of spring metal which is bent so as to form a hook to engage with the ratchet. As will readily be seen this arrangement causes the letter wheel to revolve through the space occupied by one letter every time the sounder arm is drawn down. There is also another piece of flat spring metal to prevent the wheel going backwards and also to press on the ratchet continuously so as to prevent it turning too freely and thus getting out of time.

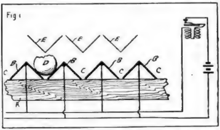
From the above description, the use of the apparatus will be plain. There is provided at each end of the line one of the letter wheel machines, a telegraph key and a battery, all connected in series as in an ordinary telegraph line. When one wishes to transmit he opens his key lever and makes "dots" until the letter he wishes comes to the opening in the shield over the type wheel, then he pauses long enough to let the receiver know that that letter is to be copied, then proceeds to the next letter and so on. The end of a word is signified by a space, and the end of a sentence by a period or question mark. The method is, by its very nature, slow, but is quite accurate, which is more than can be said of the ordinary amateur Morse line. After some practice, fair speed can be obtained though.

Certain refinements naturally suggest themselves to the amateur—such, for instance, as having an extra wire or a duplex circuit to force a strip of paper up against the wheel, which would have rubber type set on it, thus producing a printing telegraph. It is also evident that the line described is a closed circuit line and consequently gravity batteries should be used as the current flows all the time when no message is being sent. This is, of course, the most reliable type of line, but there are many well-known ways of producing an open circuit line on which ordinary dry batteries may be used.

Another method requiring a fair amount of interesting developing work is to use low frequency alternating current produced by a magneto generator to operate the apparatus. Thus, when it is desired to send a letter, the key is simply held down till the natural pulsation of the current has brought round the proper letter, when it is released for a moment. This method is entirely practical and well worth the trouble of constructing it. On lines running more than 100 ft. it is very desirable to use relays, as the current required to operate the letter wheels is too much to transmit any distance without serious loss in the line.—Chas. Horton.

Interesting Method of Learning the Telegraph Code

IN learning either of the telegraph codes one finds it easy enough to learn to transmit correctly without the aid of any other person, but, when it is desired to learn to receive, it becomes absolutely necessary either to have a teacher or some kind of apparatus to take his place. There are very few students who can afford the services of a teacher and consequently the majority must secure some sort of mechanical device to make the signals. There are several of these devices on the market but as a rule the price is a good deal beyond reach. Furthermore, in these mechanical transmitters there is not enough of the element of chance; that is, when one has used one of these instruments for a short time he gets used to the combinations employed to such an extent that the instrument loses its usefulness.



A metal ball rolling in V-shaped notches having alternate contacts and insulation

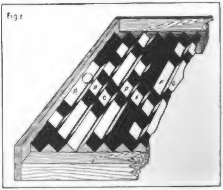
In learning the code quickly it is absolutely necessary that one never know what letter is coming next and it was to provide an arrangement in which the element of chance enters that the apparatus herewith described was developed.

Reference to Fig. 1 will serve to give an idea of the method used. The principle in use is to provide a V-shaped trough, for a metal ball to roll in, and to cover the sides of the trough with metal pads so arranged as to correspond to the telegraph signals. When the ball is caused to roll over the signals it makes corresponding contacts and a buzzer or sounder repeats them.

Thus in Fig. 1, *A* is a baseboard and *BB* are metal angles fastened to the board so as to form troughs, *CC*, between them. In each trough is glued pieces of paper or other insulation bent at right angles, as at *EE*, so arranged along the length of the trough as to form the signals. The arrangement of the parts is clearly shown in the view, Fig. 2, which is a corner of the apparatus with the cover and the front removed. It will be seen that there is provided one trough for each letter and numeral of the telegraph alphabet and the insulating pieces are pasted in to correspond to the characters forming each letter. The author uses forty characters; 26 for the letters, 9 for the numerals and 5 for punctuation marks, etc.

A cover for the box is to be made of wood or cardboard so that the ball will be prevented (when the cover is on) from jumping from one groove to another.

The simplest method of using the apparatus is to take it up with the two hands with the cover on and by tilting the box to cause the ball to roll back and forth through first one groove and then another, thus producing signals at random. It will be evident after a little thought that signals will be produced with this form of the apparatus only when the ball rolls in one direction for all letters except those which are symmetrically arranged, as for instance, *D*, *E*, etc. It will be evident to anyone with the ability to build the apparatus that a passage could be provided for the return of the ball so that meaningless signals would be prevented and also that a pivoted frame might be constructed so



The ball may roll into any one of the notches without the operators' knowledge

that the apparatus could be worked with one hand, leaving the other free to write the characters as they are produced. It is also possible to construct the apparatus in circular form by arranging the troughs around a conical piece and have the balls pushed one at a time up through the center of the cone to fall in one direction or another down the cone and enter one or other of the troughs and then return to the passage in the center to be pushed up again. It is further evident that a magnet might be arranged in connection with the above arrangement so that as soon as one ball made a contact after finishing its character the magnet would push up the next ball. Thus the machine would be entirely automatic and the operation continuous. This arrangement would make a very effectual apparatus for rapidly learning the code.

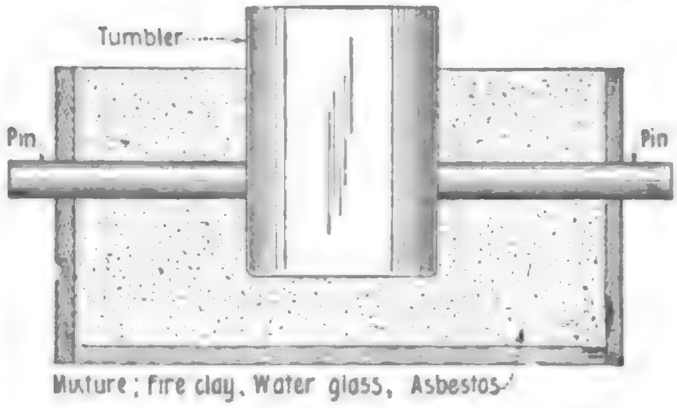
The apparatus, in order to continue to work properly, should be kept clean so that the ball will make perfect contact on the sides of the trough.

For cheap construction thin shiny tin should be used as this will not tarnish if carefully kept. A better construction is to make the angles of thin brass and have them nickel-plated. Ordinary steel ball-bearings will be satisfactory, but brass balls nickeled are better.

Home-Made Electric Furnace for Heating with Arc Light

An electric furnace of the arc type can very easily be made by anyone from the following materials: fire clay, asbestos fiber and water glass. A mixture of these ingredients will quickly dry and harden into a fireproof mass of low heat conductivity.

To make the furnace, select a box about 8 in. long and 4 in. square. Bore a hole a little above the center of each end just large enough to take a standard lighting carbon. Then mix some of the fire clay, asbestos fiber and water glass together, until a doughy mass is obtained and pack a layer 1 in. thick in the bottom of the box, forcing it down as firmly as possible. Now insert an ordinary glass tumbler in the center of the box and two wooden pins the size of light carbons in the holes at the ends. Around these pack as firmly as possible more of the mixture, filling the box completely. Smooth off the top and fill in the small cavities with a mixture of fire clay and water glass alone. In similar manner make a cover of the same size and about 1 in. thick. Place the box and



Cross section of the box filled with the mixture around the pins and tumbler

contents, together with the cover, in some warm place, preferably on the top of a furnace, and allow them to dry for about ten days. At the end of that time the box may be broken away and the pins and tumbler removed. To improve its appearance the outside may be retouched with a little fire clay and water glass. The result is a very efficient arc furnace of practically indestructible material which can be used in series with a suitable resistance on any house lighting circuit for many experiments.

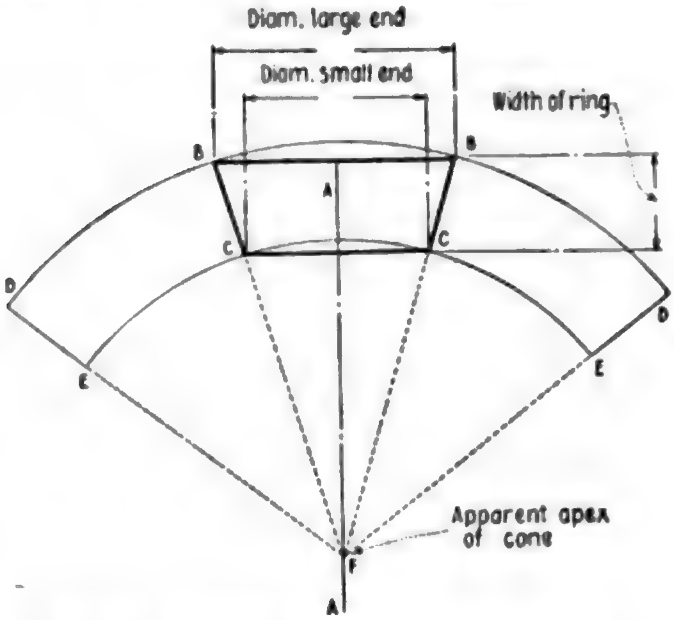
A Simple Way of Cutting Mica V-Rings to Fit on an Armature

An armature winder often experiences much difficulty in cutting a V-ring from a sheet of mica so that it will fit properly. A simple method of getting an exact fit is as follows: We will assume that the bevel surface to be covered with mica is a section of a cone, the apex of which would extend to the heart of the shaft at a point which would be the intersection of two lines, drawn as the continuation of the beveled surface of a V-ring, toward the heart of the shaft.

First, draw a perpendicular line, *A A*, on a mica sheet. Measure diameter of the large end of the V-ring with calipers. Place the measurement line, *B B*, at right with line, *A A*, taking care that the line, *A A*, cuts the line, *B B*, exactly in the center. Next, measure the diameter of the small end, and make the line, *C C*, parallel to, and at a distance from line

B B, equal to width of V-ring. Connect lines *B* and *C* on both sides, extending lines to *A A*. Call this intersection point *F*, or "apparent apex of cone."

Using *F* as the center and *B* as the radius, describe a large arc. Repeat this operation using *C* as the radius. This gives us proper curve and width of the



Method of laying out a pattern for cutting the mica V-rings used on armatures

mica V-ring, but to eliminate waste the length should also be known; the exact length is not needed and would be impractical for two reasons; first, it would involve too much figuring for the average armature winder and take up too much time; second, because provision must be made for welding mica V-ring ends together.

Therefore the exact length would be too short. To get the required length, encircle the large end of a V-ring with a piece of banding wire, allowing an extra inch for welding. Set this measurement on the large arc, and mark off the points, *D D*. Connect points *D D* with the apex, *F*. The V-ring is now all laid out and ready to cut.

A Holding Clip for Making Tests on Spark Plugs

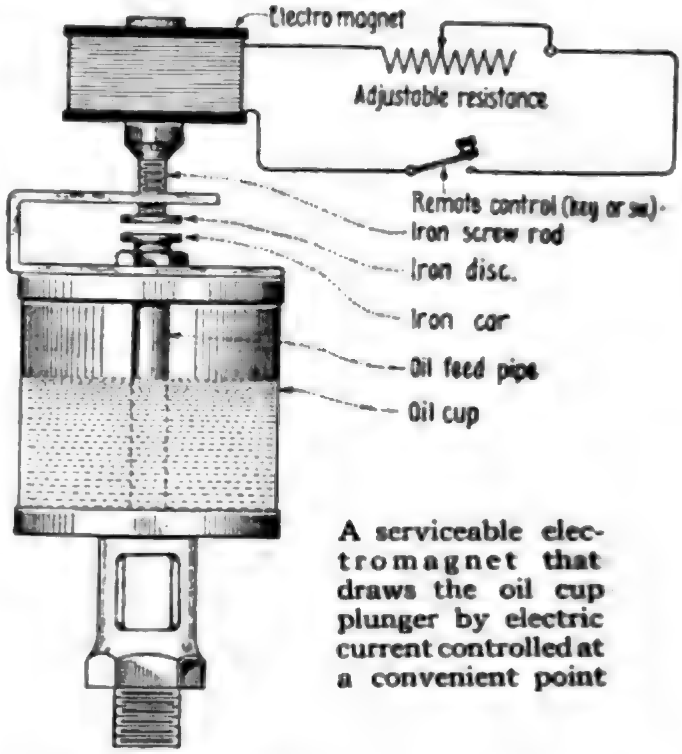
WHEN testing the spark on a set of exposed sparking plugs most car owners feel the need of special clips to grip the plugs, which have a habit of tumbling out of contact, more particularly when single plugs are being tested with the engine running. Under these circumstances, too, there is a risk of straining the magneto or coil if a plug swings past its wire without a ground. An ordinary bicycle pump clip of the double spring type makes an excellent plug holder. One end may be sprung over any convenient pipe or bolt and the inverted plug dropped into the empty end.

Controlling an Oil Cup by Means of an Electromagnet

THE magnetically operated oil cup described herewith will be found to be a very convenient means of controlling oil feed in partially inaccessible places.

An electromagnet is used in this scheme, as shown in the sketch. To open the oil cup, energize the magnet by control switch or push button. The iron disk, adjacent to the electromagnet, becomes magnetized and draws up the iron cap on the top of the oil feed pipe, and the oil will commence to drip. Upon breaking the circuit, the disk is demagnetized and the oil feed pipe, being no longer attracted, again falls and closes the feed hole.

Regulation of the flow can be obtained by adjustment of the iron disk, which is



A serviceable electromagnet that draws the oil cup plunger by electric current controlled at a convenient point

connected to a screw rod, as shown. A small electromagnet and a rheostat in series in the circuit will render the control of the oil cup quite precise. This device has considerable worth.—PETER J. M. CLUTE.

Wireless Work in Wartime

XI.—Radio transmitters using synchronous and quenched gaps

By John V. L. Hogan

IN last month's article the non-synchronous operation of a rotary gap in the wireless transmitter of Fig. 41 was decribed, for conditions which gave two or three sparks for each half-cycle of alternating current power. The curves of condenser discharge are shown in Fig. 42, where the divisions along the horizontal line represent six-hundredth parts of a second. Since the dashed wavy line shows the voltages at which the gap will permit a spark to jump, as time goes on, and the solid wavy line indicates the potential available (in the condenser) to produce a spark, it is evident that the discharge must pass whenever the two curves cross.

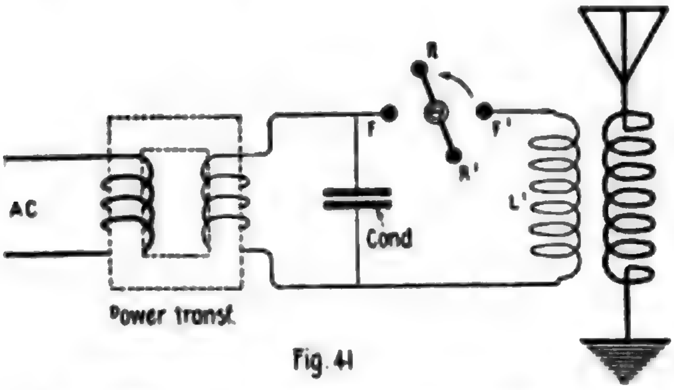


Fig. 41

A diagram of a radio transmitter with a rotary spark gap interposed in the apparatus

If we now adjust the studs so that they are somewhat nearer together, permitting the spark to pass at a lower voltage (or if we raise the maximum charging potential to a higher value), it is clear that the overlaps will occur more often and that it will thus be possible to secure four sparks in each half cycle of charging current. By proper selection of the break-down and charging voltages, by changing the wave-form of the charging voltage, and by using a power transformer which will put energy into the condenser quickly after each spark passes, it is possible to get a large number of fairly regular sparks per second with only a low frequency of alternating current power. The curves of Fig. 42 are not complete, since the secondary condenser voltage will be bound to be reduced by the withdrawal of energy for each spark; nevertheless, a sufficiently "quick" or closely-coupled power transformer will build it up again before the next sparking time, so that the general conditions will be as indicated.

For every spark there will of course be produced a group of radio frequency alternating currents in the oscillation circuit. With the non-synchronous method of operation these will not be of the greatest power obtainable from the same amount of input energy. This is because the condenser is not discharged at the instant it has been filled to its fullest (maximum potential) point for each spark. It has been pointed out that for a given capacity, the amount of charge depends upon the potential; obviously, then, if the condenser is discharged through the spark gap at a voltage of 7500 there will be less energy for conversion into oscillations than if the charge is held until the full potential of 10,000 volts is reached. The greatest utility of the non-synchronous method lies in the fact that with it one is able

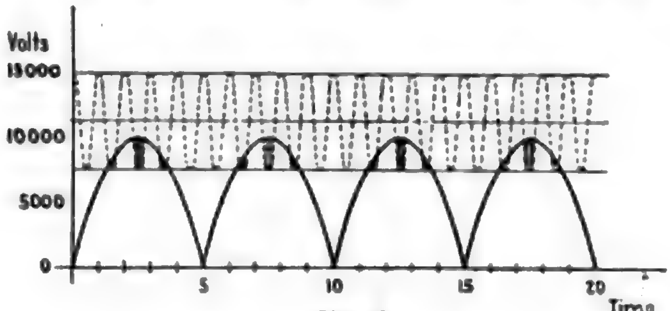


Fig. 42

Curves showing the operation of the non-synchronous spark gap for a wireless set

to secure a fairly good and moderately high-pitched spark tone from low frequency alternating current, even though at some sacrifice of conversion efficiency. By adjusting the gap for best regularity of operation, with the fewest possible

"missed sparks," a clear chord-like tone is developed. This tone, when heard at a receiving station, is much easier to read in the presence of strong atmospheric disturbances than is the low frequency rattle produced by 60 cycle current and a fixed simple spark gap, such as shown last month, and the increase in signalling effectiveness thus gained more than compensates for the loss in conversion efficiency.

Operation of the Synchronous Gap

What would happen if the rotary gap were slowed down until only one spark could pass per half-cycle of condenser voltage? This will depend mainly upon two factors: first, the instant at which the minimum break-down potential of the gap occurs, with respect to the condenser voltage curve, and, second, the value of the minimum break-down potential for which the gap is adjusted. To get the best results, the gap should reach its break-down point just at the instant the condenser reaches its maximum charge, as shown in Fig. 43. Here the dashed line again represents break-down voltages, and it is seen how the gap reaches its favorable position for sparking just as the condenser secures its maximum charge. To maintain these conditions it is necessary to mount the rotary gap element directly upon the shaft of the generator which produces the alternating current for the power transformer, so that the time-relation between the two variables will be strict and unchanging. A careful adjustment must be made, by moving the fixed electrodes backward or forward around the circumference of the gap, so that the shortest gap length occurs just when the condenser is ready for discharge; otherwise no spark will pass, or else only part of the energy will be drawn from the condenser at each discharge. This method of working is called the synchronous discharge, since the applied voltage and the gap-discharge voltage vary automatically together or synchronously. It provides what is probably the best method of securing maximum power together with a spark regularity so perfect that a clear musical spark tone is had at any frequency. To get high pitched spark tones, however, a fairly high frequency alternating current must be used, since there is only one spark for each half cycle. Thus a 500 cycle current, as shown in Fig. 43, will produce a spark tone of 1,000 impulses per second. As before, each discharge generates a group of radio frequency oscillations in the primary circuit consisting of the condenser, spark gap and inductance L_1 (of Fig. 41).

It should be noted that in general the non-synchronous method of operation involves the use of a rotary gap driven by a separate direct current motor without any particular relation to the input frequency, and that the sparking and missing times occur at random. In Fig. 42 is shown a perfectly adjusted relation

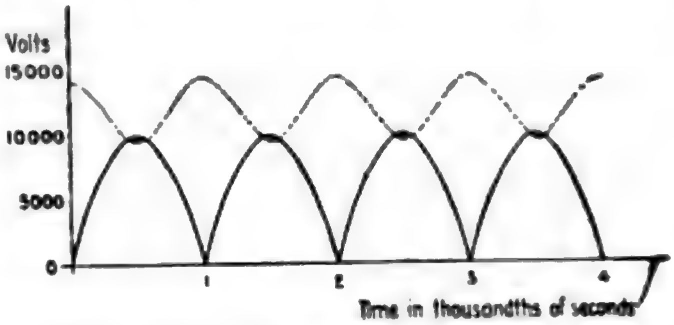


Fig. 43

Break-down point should be reached when the condenser reaches the maximum charge

between the gap frequency and that of the applied current which is almost impossible to hold in practice, although it may often exist for short times. With the separately driven gap it is possible to slow down the discharge frequency until it is exactly twice that of the applied alternating current power, and so to approximate the synchronous discharge condition. It is impossible to maintain the instant of discharge correctly in phase (or in step) with the power current in this way, however, and consequently for best synchronous operation, the direct mechanical connection of the rotary gap and the generator, must be relied upon.

Construction of the Quenched Gap

A fourth type of gap, shown in Fig. 44, is largely used in spark transmitters. This usually consists of highly cooled enclosed parallel sparking surfaces, often of silver, which are mounted in pairs and separated only about 1-100 in. The sparking potential of such a gap unit is about 1,000 volts, and to build up the breaking-down potential to a higher value

a number of the units or pairs are connected in series. This construction has received the name of "quenched gap," since when it was first used it was presumed to have an especially effective quenching or extinguishing action upon the spark passing across it. The quenching action is now generally held to be more dependent upon the correlation of circuit adjustments than on the gap structure itself, however, as will be explained later, and the gap is merely one form of device which is capable of giving extremely uniform operation. This regularity of operation depends largely upon the fact that the current through the gap is kept small, and the surfaces are kept clean and parallel, so that successive discharges take place from different portions of the discharge plates. Thus extreme heating of any one point is prevented, and the gap may be relied upon to discharge at a quite definite potential time after time.

The basic operation is exactly as in all the other spark gaps considered. The construction shown in Fig. 44 involves plates having cooling flanges, separating feet and the silver sparking surfaces indicated respectively by *F*, *G* and *H*, which are placed face to face (spaced accurately by the insulating gaskets *I*) in pairs as shown. The entire group of from six to thirty or forty units is clamped together in a special form of rack.

This quenched gap is connected into the normal circuit of Fig. 41, replacing the rotary gap there shown. For best operation it requires a circuit adjustment somewhat different from that used with the rotary gap, since with "quenching" operation the endeavor is to transfer the energy of the radio frequency oscillating currents across the transformer with primary L_1, into the antenna circuit, in the shortest possible time. Under these conditions, the gap discharges so regularly that a pure musical signal tone is heard at the receiver. The technical differences between so-called "quenching" and "non-quenching" operation may be understood from a study of such authoritative treatises as Zemeck's "Wireless Telegraphy"; the principles given in the foregoing are sufficient to bear in mind during the first survey of the action. The war-time student requires only such a grasp of the general subject of radio as will permit him to get into practical field work at the earliest moment.

Production of Radio Waves

The oscillating currents of the condenser circuit (Fig. 41) are transferred into the antenna and ground circuit by the transformer action of coil L_1 upon its secondary. Similar radio frequency currents are consequently generated, in groups, in the aerial wires which stretch upward to the mast top. These antenna currents result in the production of radiant ether waves of the same radio frequency. The wireless waves pass outward over the surface of the earth, in all directions, at the speed of 186,000 miles per second; some small portion of the radiated wave energy reaches the receiver to which the messages are sent.

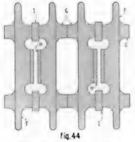


Fig. 44
Separating feet and sparking surfaces

The closing articles of this series will take up the interception of the radio waves at the receiving station.

Mind Reading by Wireless—Try It on Wise Friends

THE mind reader bounds up every few months. The feats he can perform are little short of marvellous. William Dubilier of New York has given the following details to the POPULAR SCIENCE MONTHLY of how many of these mind readers work. Any wireless enthusiast can set up equivalent apparatus and obtain equally good results.

Dress yourself or a friend up as the mind reader. Oriental costumes are all the style in the mind-reading profession, and in this case are especially necessary because a Turkish or Indian turban makes an excellent headpiece by which the mind reader can conceal a pair of telephone receivers clamped to his ears. Around his body just beneath the shoulders are wound some 100 turns of No.

30 double cotton-covered copper wire, the ends being directly connected to the receivers. All wiring is of course concealed by the mind reader's cloak, his turban, and perhaps a high collar of some sort around his neck. Wired up in this way, the mind reader is ready for action.

But the mind reader must have an accomplice. The idea is that some member of the audience before which exhibitions are given be requested to show something to this "friend" (the accomplice), whereupon the mind reader will tell what it is. For instance, the "friend" may be shown a watch, and the mind reader requested to tell what time it is. Or perhaps the object exhibited happens to be a newspaper and the person with occult powers is asked to tell what headline the exhibitor has his finger upon. Many such tests can be devised.

Around the accomplice's body just beneath the arms, in the same way as in the case of the mind reader, are wound about fifteen turns of No. 16 double-cotton-covered wire. This serves as a sending "aerial," while the turns on the mind reader serve as a receiving "aerial." As shown in the diagram, the turns of wire on the accomplice are in series with several cells of flashlight battery concealed in some manner on his person.

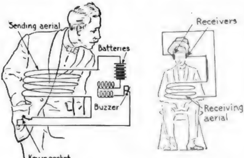
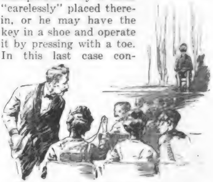


Diagram showing the arrangement of parts on the body for mind reading sending and receiving

Also in the circuit are a key and a small, almost-noiseless buzzer, likewise concealed.

When the person who sets out to test the mind reader's powers holds something up before the accomplice, the accomplice of course reads it, or otherwise notes what is necessary, and telegraphs the information to the mind reader over the miniature, short-range wireless just described. The accomplice may have his key in a coat or trouser's pocket and manipulate it by a hand "carelessly" placed therein, or he may have the key in a shoe and operate it by pressing with a toe. In this last case considerable skill is necessary, but by diligent practice professional accomplices sometimes attain great proficiency.



The audience being entertained by a seemingly miraculous way of mind reading

The accomplice may wander anywhere about the room, wherever he may be called, in fact, by those who desire to test the mind reader's powers. Still the wireless works regardless of the changes in position. By pretending that peculiar psychopathic influences exist between accomplice and mind reader, the illusion may be heightened. The audience will wonder how any two persons can carry on thought transference to any such great extent. Yet the initiated wireless man knows!

While the amateur is now barred from using his wireless instruments, this idea presents a new and interesting way of making use of parts of his apparatus and of keeping in practice in sending and receiving. It also provides entertainment for his friends. The apparatus is not difficult to construct and it may be used many times in school work or for private theatricals as a paramount feature for the evening entertainment. Amateurs who have put the idea into execution are enthusiastic regarding it.

Popular Science Monthly

225 West Thirty-ninth St., New York

Volume 92 Waldemar Kaempffert, Editor No. 1

Contents for January, 1918

CONTENTS FOR JANUARY—Continued

POPULAR SCIENCE MONTHLY is issued monthly. Yearly subscription in the United States $1.50. Canada, $2.00. Foreign $2.50. SINGLE COPY, 15 cents.

POPULAR SCIENCE MONTHLY may be had at all news stands in the United States and Canada; also from the International News Company, Breams Bldg., Chancery Lane, London. E. C., and at Brentano's, 37 Avenue de l'Opéra, Paris.

Forms close the twentieth of the second month preceding date of publication. Advertising rates on application. Entered as second class matter at the New York Post Office, under the Act of Congress of March 3, 1879.

H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.

MODERN PUBLISHING COMPANY, 225 West Thirty-ninth St., New York City

Popular Science Monthly

225 West Thirty-ninth St., New York

Volume 92 — Waldemar Kaempffert, Editor — No. 2

Contents for February, 1918

CONTENTS FOR FEBRUARY—Continued

POPULAR SCIENCE MONTHLY is issued monthly. Yearly subscription in the United States $1.50. Canada, $2.00. Foreign $2.50. SINGLE COPY, 15 cents.

POPULAR SCIENCE MONTHLY may be had at all news stands in the United States and Canada; also from the International News Company, Breams Bldg., Chancery Lane, London, E. C., and at Brentano's, 37 Avenue de l'Opéra, Paris.

Forms close the twentieth of the second month preceding date of publication. Advertising rates on application. Entered as second class matter at the New York Post Office, under the Act of Congress of March 3, 1879.

H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.

MODERN PUBLISHING COMPANY, 225 West Thirty-ninth St., New York City

Popular Science Monthly

225 West Thirty-ninth St., New York

Volume 92 Waldemar Kaempffert, Editor No. 3

Contents for March, 1918

CONTENTS FOR MARCH—Continued

POPULAR SCIENCE M[illegible] nada, $2.00.
Foreign $2.50. SIN[illegible]
POPULAR SCIE[illegible] n the International News Com[illegible] l'Opéra, Paris
Forms close [illegible] on application
Entered as [illegible] 1879.
The conte[illegible] H. J. Fisher,
President; R. [illegible]

MO[illegible] York City

lar Science Monthly

225 West Thirty-ninth St., New York

Waldemar Kaempffert, Editor — No. 4

Contents for April, 1918

CONTENTS FOR APRIL—Continued

POPULAR SCIENCE MONTHLY is issued monthly. Yearly subscription in the United States $1.50. Canada, $2.00. Foreign $2.50. SINGLE COPY, 15 cents.

POPULAR SCIENCE MONTHLY may be had at all news stands in the United States and Canada; also from the International News Company, Breams Bldg., Chancery Lane, London, E. C., and at Brentano's, 37 Avenue de l'Opéra, Paris.

Forms close the twentieth of the second month preceding date of publication. Advertising rates on application. Entered as second class matter at the New York Post Office, under the Act of Congress of March 3, 1879. Entered as second class matter at Post Office Department, Canada.

H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.

MODERN PUBLISHING COMPANY, 225 West Thirty-ninth St., New York City

Popular Science Monthly

225 West Thirty-ninth St., New York

Volume 92 Waldemar Kaempffert, Editor No. 5

Contents for May, 1918

CONTENTS FOR MAY—Continued

POPULAR SCIENCE MONTHLY is issued monthly. Yearly subscription in the United States $1.50. Canada, $2.00 Foreign $2.50. SINGLE COPY, 15 cents.

POPULAR SCIENCE MONTHLY may be had at all news stands in the United States and Canada; also from the International News Company, Breams Bldg., Chancery Lane, London. E. C., and at Brentano's, 37 Avenue de l'Opéra, Paris.

Forms close the twentieth of the second month preceding date of publication. Advertising rates on application. Entered as second class matter at the New York Post Office, under the Act of Congress of March 3, 1879. Entered as second class matter at Post Office Department, Canada.

H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.

MODERN PUBLISHING COMPANY, 225 West Thirty-ninth St., New York City

Popular Science Monthly

225 West Thirty-ninth St., New York

Volume 92 — Waldemar Kaempffert, Editor — No. 6

Contents for June, 1918

CONTENTS FOR JUNE—Continued

POPULAR SCIENCE MONTHLY is issued monthly. Yearly subscription in the United States $1.50. Canada, $2.00 Foreign $2.50. SINGLE COPY, 15 cents.

POPULAR SCIENCE MONTHLY may be had at all news stands in the United States and Canada; also from the International News Company, Breams Bldg., Chancery Lane, London, E. C., and at Brentano's, 37 Avenue de l'Opéra, Paris

Forms close the twentieth of the second month preceding date of publication. Advertising rates on application. Entered as second class matter at the New York Post Office, under the Act of Congress of March 3, 1879. Entered as second class matter at Post Office Department, Canada.

H. J. Fisher President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.

MODERN PUBLISHING COMPANY, 225 West Thirty-ninth St., New York City

The Art Color Printing Co., New York

The *New* Shaving Stick

COLGATE'S

"HANDY GRIP"

Patented 1917

COLGATE'S "Handy Grip" combines economy, convenience, speed, and comfort better than any other shaving preparation. We couldn't improve the soap, so in each detail of economy and convenience we improved the box to make it worthy of its contents.

The Last Word in Shaving Convenience & Economy

A "Handy Grip" should be in every soldier's kit

FEBRUARY Reg U.S. Pat Off. 15 Cents

NOTICE TO READER

When you finish reading this
zine, place a 1-cent stamp on
notice, hand same to any posta
ployee and it will be placed i
hands of our soldiers or sailors a
front. NO WRAPPING—NO ADD

Popular Science

Founded MONTHLY

300 Pictures

See page 210

Victor
"HIS MASTER'S VOICE"
REG. U.S. PAT. OFF.
The greatest music
by the greatest artists
-only on Victrola Records
Who are the greatest artists?
The talented singers and instrumentalists who by reason of their superior artistry are famous the whole world over
—who charm hosts of music-lovers upon their appearance on the opera and concert stage
—who have chosen Victrola Records exclusively to carry their art to all the world and immortalize them for all time.
Hear your favorite music today at any Victor dealer's. He will gladly play for you any Victrola Records by the world's greatest artists, and give you a copy of the Victor Record catalog—the most complete catalog of music in all the world. Ask to hear the Saenger Voice Culture Records.
Victor Talking Machine Co., Camden, N. J., U. S. A.
Berliner Gramophone Co., Montreal, Canadian Distributors
Important Notice: Victor Records and Victor Machines are scientifically coordinated and synchronized by our special processes of manufacture, and their use, one with the other, is absolutely essential to a perfect Victor reproduction.
New Victor Records demonstrated at all dealers on the 1st of each month
Caruso as Rhadames in Aida
7 Gluck as Nedda in Pagliacci
8 Scotti as Scarpia in Tosca
9 Homer as Amneris in Aida
11 Tetrazzini as Lakme
13 Martinelli as Mario in Tosca
14 Calvé as Carmen
18 De Luca as Figaro in Barber of Seville
19 Whitehill as Amfortas in Parsifal
20 Mischa Elman

MARCH

Reg U.S. Pat. Off.

15 Cents

Popular Science

Founded MONTHLY *1872*

300 Pictures

Firing at towed
Target. See P.


ARMY
NAVY
TRADE MARK FACE
'Ever-Ready' $1
Safety Razor
and 'Ever-Ready' Radio Blades
Officially adopted by Uncle Sam for all cantonments of the New Army.
Extra 'Ever-Ready' Radio Blades 6 for 30¢
AMERICAN SAFETY RAZOR CO. Inc. Brooklyn, N.Y.

postal employee and it will be placed in the hands of our soldiers or sailors at the front. No wrapping

No address.

APRIL

Reg. U.S. Pat. Off.

15 Cents

Popular Science

Founded MONTHLY

The "Dewdrop"

SENECA CAMERAS

LIKE the Indian Tribe, after which they are named, Seneca Cameras are thoroughly American.

They want to help win the war by taking pictures here at home for the Soldiers in France and in the Training Camps.

Seneca stands for picture making satisfaction. Get a catalog from your dealer and choose your model. Home pictures will cheer your soldier.

Seneca Camera Mfg. Company

157 State St., Rochester, N.Y.

U. S. A.

Seneca Folding Scout

3A Size Takes $3\frac{1}{4}$ x $5\frac{1}{2}$ in. Pictures

$13


MARMON
34
1100 Pounds Lighter
Roominess is an outstanding Marmon excellence—wider seats and deeper sides—notwithstanding that the Marmon is closer to the ground than comparable cars. View this open model at the motor shows.
NORDYKE & MARMON COMPANY
Established 1851
INDIANAPOLIS

"Yes, that's right – the Bayer Cross"

THE BAYER CROSS appears on the Only Genuine Aspirin, made in the United States for more than 10 years.

"It is better to be safe than sorry" is an old saying that is particularly applicable to the purchase of pharmaceutical preparations, and is strikingly true in the case of Aspirin.

Why? Because unscrupulous dealers have adulterated Aspirin, as confirmed by the Boards of Health of various large cities. There have been instances in which dangerous drugs have been sold in place of it. Therefore, you are right in insisting that every package and every tablet bears

"The Bayer Cross—

Your Guarantee of Purity"

[illegible] trade-mark "Aspirin" (Reg. U. S. Pat. Off.) is a guar- [illegible] that the monoaceticacidester of salicylicacid in these [illegible] and capsules is of the reliable Bayer manufacture.

BAYER-TABLETS
Pocket Boxes of 12
Bottles of 24 and 100

"AND NIGHT IS FLED
WHOSE PITCHY MANTLE OVER-VEIL'D THE EARTH"
—*Shakespeare*

JORDAN

Sport Marine

THE FIRST COMPLETELY EQUIPPED MOTOR CAR

Including new Continental power unit, custom made, all aluminum body, five Silvertown cord tires, five wire wheels, and many other detail refinements in regular equipment.

Price $2375. F. O. B. Cleveland

JORDAN MOTOR CAR COMPANY
CLEVELAND OHIO

BEST IN THE LONG RUN

A Classic among Classics

MODELED as by a sculptor, the lithe gracefulness of the classic *Goodrich Silvertown Tire* would fit harmoniously into the classic company of an art gallery.

These patrician tires dress any car with an individual elegance, give it a smoother riding comfort, found only where you find the Red Hallmark of tire quality and service, The Red Double-Diamond.

The elegance outside clothes strength within—the *structural strength* of the patent-protected cable-cord tire body, and the *proven strength* of Goodrich Tested Tires—**BLACK SAFETY TREADS, or SILVERTOWN CORDS.**

Leagues upon leagues of grinding and ploughing against real road conditions prove for you the certainty of long mileage, and freedom from tire trouble of "America's Tested Tires."

GOODRICH
TESTED TIRES

The B. F. Goodrich Rubber Co.

THE CITY OF GOODRICH · AKRON, OHIO.

The aristocrat of fire-safe roofings

COLORBLENDE SHINGLES

of JOHNS-MANVILLE ASBESTOS

New and Distinctive Color Effects in Roof Design

BY their rich softness of color and texture, Colorblende Shingles give to roofs a new and interesting distinction. And they are as fire-safe and practical as they are beautiful.

Colorblende Shingles accurately indicate the quality of the whole Johns-Manville Roofing Line, which includes a fire-safe, economical roofing for every requirement.

Transite Asbestos Shingles, lower in cost but equally durable — Asbestos Built-Up Roofing for flat roofs — Asbestos Ready Roofing for sloping roofs — Corrugated Asbestos Roofing for skeleton framing. Booklets on request.

H. W. JOHNS-MANVILLE CO.
New York City
10 Factories—Branches in 60 Large Cities

1. Roof effect in autumn tones, secured by laying four shades of Conglomerate Brown and No. 50 Standard Red Shingles.

SIXTIETH ANNIVERSARY

Sixty successful years

Sixty years have been devoted by Berry Brothers to the study of the manufacture of varnish. The sum of the knowledge thus gained is evidenced in the superior quality of our various products. This quality is a guaranty of beauty and permanence, and the Berry label a safe guide for every user or buyer of varnish.

Write for our new booklet illustrating various attractive schemes for using the following Berry Finishes.

Luxeberry White Enamel
Luxeberry Wall Finishes
Luxeberry Wood Finish
Luxeberry Spar Varnish
Liquid Granite Floor Varnish
Berrycraft Stain Finish
Auto Color Varnishes
Floor Wax

Berry Bros., Inc. Detroit, Mich. Walkerville, Ont. San Francisco

(640)

Berry Brothers

STAINS VARNISHES ENAMELS

South Bend

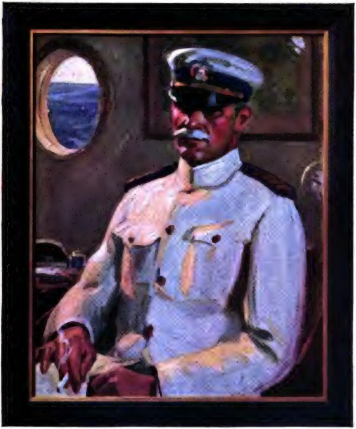
The Watch with the Purple Ribbon

As soon as your jeweler shows you the Watch with the Purple Ribbon, you will detect a nicety of finish and a beauty of design which tell of skilful workmanship and high manufacturing standards. And the experienced jeweler will confirm your own favorable opinion.

The Chesterfield *Extra-Thin* models are particularly noteworthy examples of how modern watch experts may combine beauty and thinness with the year-in year-out accuracy which exacting watch owners demand. Prices range from $20.00 to $125.

See these watches of style and accuracy at your jeweler's and let us send you "A Book of Beautiful Watches."

South Bend Watch Company, 23 Studebaker St., South Bend, Ind.
For Years, Makers of Standard Railroad Watches



PAINTED FOR LIGGETT & MYERS TOBACCO CO.

THE noticeable preference for Fatimas in the Army and Navy among officers and men alike is due, of course, to the very same thing that makes Fatimas so widely popular in every-day life.

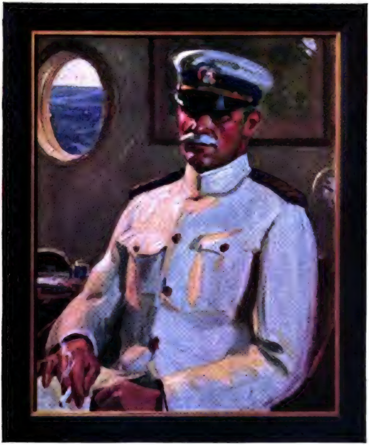
In addition to their pleasing taste, Fatimas offer true smoking *comfort*—while being smoked and afterwards, too. So that, even if occasionally a man does smoke more often than usual, Fatimas never unpleasantly remind him of it.

That is true smoking *comfort;* common sense in cigarettes. It is why Fatimas are known as a sensible cigarette.

Liggett & Myers Tobacco Co.

FATIMA

A Sensible Cigarette 15¢



PAINTED FOR LIGGETT & MYERS TOBACCO CO.

VEY TREE SURGEONS

Estate of the late Joseph H. Choate, Stockbridge, Mass., famous alike for the greatness of its owner and the charm of its artistic and mature setting

THE fine old trees on this beautiful estate were intrusted to the skilful care and masterful art of Davey Tree Surgeons. The results have been more than gratifying. Among hundreds of distinguished Davey Tree clients are:

Capt. J. R. DeLAMAR
Dr. ANNA SHAW
Mr. THOMAS E. WILSON
Mr. E. T. STOTESBURY
Mr. FREDERICK W. VANDERBILT
Mrs. K. DEXTER McCORMICK
Hon. MYRON T. HERRICK
Mr. JESSE ISIDOR STRAUS

The saving of priceless trees is a matter of first importance on every estate. Davey Tree Surgery is a fulfillment of the maximum expectations of those who love and value trees. A careful examination of your trees will be made by appointment.

THE DAVEY TREE EXPERT CO., 203 ELM ST., KENT, OHIO
Branch Offices, with telephone connections: 225 Fifth Ave., New York
2017 Land Title Bldg., Philadelphia; 450 McCormick Bldg., Chicago

Permanent representatives located at Albany, Baltimore, Boston, Buffalo, Cincinnati, Cleveland, Detroit, Harrisburg, Hartford, Jamaica, L. I., Kansas City, Lenox, Louisville, Milwaukee, Minneapolis, Newark, N. J., Newport, Pittsburgh, Poughkeepsie, St. Louis, Stamford, Washington, White Plains.

John Davey, Father of Tree Surgery

Canadian address
22 Victoria Square, Montreal.

Every real Davey Tree Surgeon is in the employ of The Davey Tree Expert Company, and the public is cautioned against those falsely representing themselves.

The aristocrat of

COLOR-BLENI

of JOHNS-MANV

Plate II—A suggestion in roof coloring embodying No. 50 Standar

The aristocrat of

COLOR-BLENI

of JOHNS-MANV

Plate II—A suggestion in roof coloring embodying No. 50 Standar


WAY SAGLESS SPRING CO.
WAY
MINNEAPOLIS, MINN.


The New
Studebaker
BIG SIX
Beautiful in design
Thoroughly modern
Mechanically right
STUDEBAKER
Detroit, Mich. South Bend, Ind. Walkerville, Ont.
Address all correspondence to South Bend


BEST IN THE LONG RUN
FAIR TREATMENT
The Secret of Shock Resistance
WIRE-WOUND big guns, built of spiral or coil-wrapped cable, withstand greater firing stress, and last longer than ordinary guns. Says Popular Science:
"The big gun bound with wire is really stronger than one built of rings or bands of Steel * * In making a wire-wound gun, the wire is wound round and round * * over a hundred miles."
With cable-cord (a sturdy, resilient fusion of cord and rubber) supplanting wire, Goodrich Silvertown Cord Tires are built like wire-wound big guns. Built thus to resist road shock, they outlast ordinary tires.
Practical usage confirms science. SILVERTOWN CORDS and BLACK SAFETY TREADS, put to nation-wide road tests by Goodrich Test Car Fleets, have proved the durability and dependabilty of—
GOODRICH
TESTED TIRES
The B. F. Goodrich Rubber Company
THE CITY OF GOODRICH · AKRON, OHIO.

JST LIKE NEW
ME
pared Wax you
your home at-
your piano, fur-
oors and lino-
ishes and pro-
ig years to its
nson's Pre-
n both
rm.
for
the CAR
You will find Johnson's Prepa
Wax an ideal polish for the bo
hood and fenders of your car.
imparts a high, dry, glasslike lu
—preserves and protects the
nish—sheds water and dust—
makes a "wash" last twice
long. The liquid form
quires but little rubb
S. C. Johnson &
Racine,
JOHNSON'S
PREPARED WAX
LIQUID
S. C. JOHNSON & SON
on's Prepared Wa
iquid and Paste

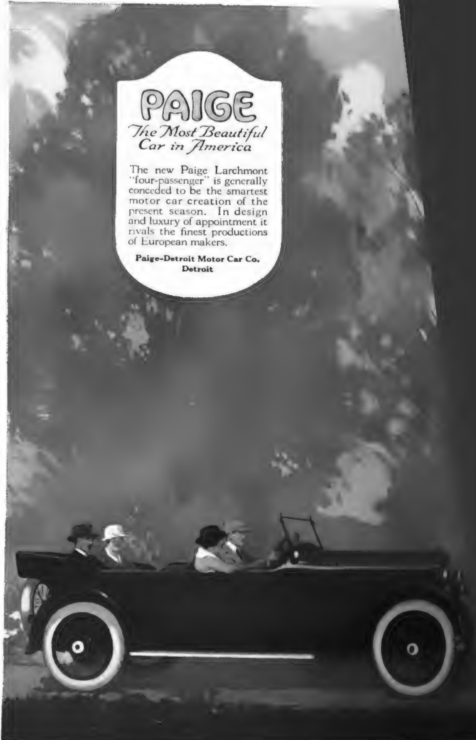
More and more they come to HAVOLINE OIL

Experience is the great teacher when it comes to knowing what helps your motor attain 100% performance. When you come to Havoline Oil for your motor, you will detect the difference immediately. You will thoroughly appreciate the difference after a few weeks. You will be glad of the difference if, after a few years, you decide to sell your car or trade it in for a new one.

Havoline Oil is the safest oil you can use in your motor, no matter what the car, the model, the season, or the driving condition. This has been proven by a vast majority of the better-class owners of cars throughout the country.

Havoline greases are compounded of Havoline Oil and pure, sweet tallow. Clean to handle and correct in body.

Indian Refining Company, New York
Incorporated
Producers and Refiners of Petroleum


PAIGE
The Most Beautiful Car in America
The new Paige Larchmont "four-passenger" is generally conceded to be the smartest motor car creation of the present season. In design and luxury of appointment it rivals the finest productions of European makers.
Paige-Detroit Motor Car Co.
Detroit


umanity's Light

The aristocrat of fire-safe roofin

COLORBLENDE SHIN

of JOHNS-MANVILLE ASBES

A Roof where Beauty and Utility meet

A ROOF texture of exceptional interest, gained by the apparently accidental blending of rich color and soft shingle outlines. A roof that is safe, too, from the threat of communicated fire and free from costly upkeep.

Colorblende Shingles are typical of the Johns-Manville Roofing Line, and have fairly earned their place in a list which meets your every roofing need.

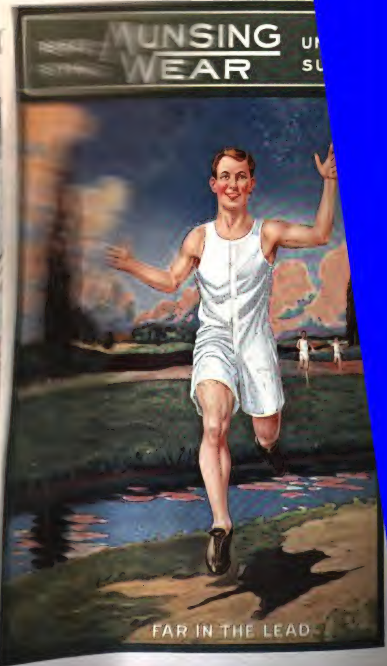
Colorblende Shingles, Asbestos Ready Roofing
Transite Shingles, Asbestos Built-Up Roofing
Corrugated Asbestos Roofing
Booklets on request

H. W. JOHNS-MANVILLE CO.
NEW YORK CITY
10 Factories—Branches in 61 Large Cities

Fig. No. 1—An attractive roof effect secured by the use of Conglomerate Brown Shingles.


BEST IN THE LONG RUN
FAIR TREATMENT
"When Spring unlocks the earth
to loose the smiling flowers"
WHEN blooming orchards, and the green bosoms of the hills call you to the open, and you speed your motor car to the country, sweet with the breath of new things, be sure to make your first flight of Springtide on Silvertown Cord Tires.
Half your joy, as you read the joyous book of Spring, writ in blossoms, lies in Silvertowns, the graceful, patrician tires with the Red Hallmark of tire quality—the Red Double Diamond—inlaid in the side wall.
Buoyant as the Spring air, they give you the leaping joy of ease and comfort. They give the calm joy of security.
For the durability and dependability of SILVERTOWN CORDS, along with BLACK SAFETY TREADS, have been proved by Goodrich Test Car Fleets. They measure up to the new tire standard, which supersedes all standards, the TESTED of—
GOODRICH
TESTED TIRES

C



[redacted]

new Six so completely meets the requirements
uality, appearance, price, economy, room, com-
d speed that it has been called "the ideal five-
er car." Its lines are clean-cut and aristocratic.
most economical Quality Six on the market.
k acceleration and hill-climbing qualities are
ble, and it combines speed with comfort.
accessible, and easy to drive.

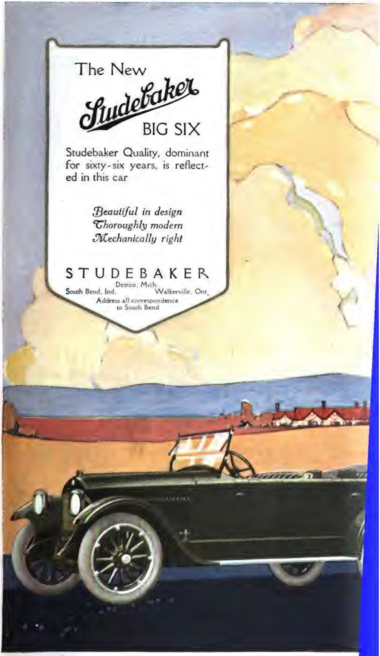
l in design—Thoroughly modern—Mechanically right

STUDEBAKER

it, Mich. South Bend, Ind. Walkerville, Ont.

Address all correspondence to South Bend

C



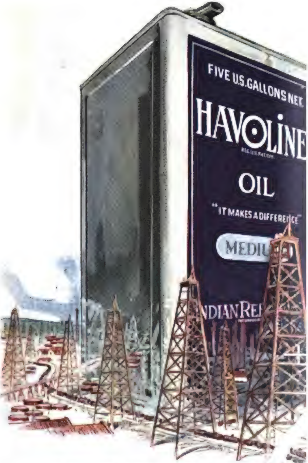
The New
Studebaker
BIG SIX

Studebaker Quality, dominant for sixty-six years, is reflected in this car

Beautiful in design
Thoroughly modern
Mechanically right

STUDEBAKER
Detroit, Mich.
South Bend, Ind. Walkerville, Ont.
Address all correspondence to South Bend

image
not
available



ALWAYS UNIFORM

The character of Havoline Oil is absolutely fixed. It never varies. It is as uniform as gold. Havoline Oil never differs, even occasionally, from its fixed, highly corrected standards of lubrication of motor cars.

We produce our own crude, pump through our own pipe-lines, ship in our own tank-cars, refine by an exact and uniform process, and distribute the finished product in the sealed Havoline container. This is your guarantee of uniformity, highest quality, full quantity, no impurities, and all-Havoline.

The unvarying uniformity of Havoline Oil explains the invariable use of Havoline by a vast majority of the better class motorists.

Havoline greases are compounded of Havoline Oil and pure, sweet tallow. Clean to handle and correct in body

Indian Refining Company, New York
Incorporated
Producers and Refiners of Petroleum

image
not
available

At Graduati

THE most appropriate and most appreciated gift is a high-grade watch. In mahogany-finished, velvet-lined gift boxes and encased in distinctively designed, hand-wrought Solid Gold cases, the 21-Jewel *Extra-Thin* South Bend Chesterfield Watches at $125, $100 and $80, and the 17-Jewel models at $75 and $55, offer accuracy and beauty usu
expensive t

There are c
also, at aln
to pay.
stylish and
dependable

See them :
Book of F
be sent yo

SOUTH BEND WATCH C
26 Studebaker Street, South Benc
For Years, Makers of Standard Railroad

South B

The Watch with the P

image
not
available

PAIGE

The Most Beautiful Car in America

There is a world of satisfaction in owning a motor car that is a constant source of pride—a car that reflects, not only your good taste, but your sound judgment as well.

The Paige is just such a car.

Paige-Detroit Motor Car Co.
Detroit

image
not
available

From an original painting in oils, showing a spot of great natural beauty on the new country estate property of Mr. Irenée du Pont, near Wilmington, Delaware

THE first thought of Mr. du Pont was the pres
and well-being of his fine old trees. In designi
estates or modest country places, there are gener
tain trees around which the whole plan is deve

Many an owner has located his house, drives and entrance in
special trees, only to find, too late, that they were past sav
been irreparably injured in the execution of the other work.

What Mr. du Pont is doing on his estate in assuring the healt
of the trees first, should be done in every instance. This highl
work was intrusted by Mr. du Pont to the demonstrated sk
Tree Surgeons. Among hundreds of distinguished Davey

Mr. VINCENT ASTOR
Mr. J. OGDEN ARMOUR
Mr. P. A. B. WIDENER
Mrs. JOHN J. ALBRIGHT
Sen. CLARENCE W.
Mr. ISAAC UNTERM
Mr. WM. M. WOOD
Hon. JAS. R. GARFI

A careful examination of your trees will be made by ap

JOHN DAVEY
Father of
Tree Surgery

DAVEY TREE EXPERT CO., 206 ELM ST., KE

Branch Offices, with telephone connections: 225 Fifth Ave
2017 Land Title Bldg., Philadelphia; 450 McCormick Bl

DAVEY TREE SURGE

WRITE NEAREST OFFICE

Permanent representatives located at Boston, New
Hartford, Stamford, Albany, Poughkeepsie, Wh
Jamaica, L. I., Newark, N. J., Harrisburg, Baltimore,
Buffalo, Pittsburgh, Cleveland, Detroit, Cincinnati,
Milwaukee, Minneapolis, St. Louis, Kansas City.
address: 22 Victoria Square, Montreal.

Every real Davey Tree Surgeon is in the employ of the Davey Tr
pany, and the public is cautioned against those falsely represen

The Triumphal March of

Bevo

REG. U.S. PAT. OFF.

THE BEVERAGE

America's Soft Drink Supreme

Came - I Saw Conquered

Iilk or water may contain acteria: Bevo never does.

pproved for use by the overnment and immensely opular in the U. S. Canton- ents and on Men-o'-war.

NHEUSER-BUSCH ST. LOUIS

eight-million-dollar
ttling and shipping
rgest in the world.
26 acres of floor
pacity of 2.000.000
lay—employment of
rsons.

Victor Re

-the living e *of an artist's g*

What is it that makes an artist applause of appreciative audiences? viable reputation as a great artist in

The answer is indelibly inscribed are the living evidence of an artist' duce the art of the most famous si with unswerving fidelity.

With the Victrola you can enjo tions at will right in your own h *Victrola*—for the world's greatest a Victrola exclusively.

Any Victor dealer will gladly play for and demonstrate the various styles of the Victor and Victrola—$10 to $400. Period styles to order from $375 to $950. Saenger Voice Culture Records are invaluable to vocal students—ask to hear them.

Victor Talking Machine Co.
Camden, N. J., U. S. A.

Berliner Gramophone Co., Montreal
Canadian Distributors

Important Notice. Victor Records and Victor Machines are scientifically coordinated and synchronized in the processes of manufacture, and their use, one with the other, is absolutely essential to a perfect reproduction.

New Victor Records demonstrated at all dealers on the 1st of each month

Victor
Supremacy

Vic


Bevo
VIDI - VICI
The Triumphal March of
Bevo
THE BEVERAGE
America's Soft Drink Supreme
Came - I Saw
Conquered
Iilk or water may contain
acteria: Bevo never does.
pproved for use by the
overnment and immensely
opular in the U. S. Canton-
ents and on Men-o'-war.
NHEUSER-BUSCH ST. LOUIS
eight-million-dollar
ttling and shipping
rgest in the world.
26 acres of floor
pacity of 2.000.000
lay—employment of
rsons.

Be A Certific
ELECTRIC

Your Future

is in Electricity
Obey that "Hunch."
Get a Move on Yourself —Here's Your Chance

If You Act Quick I Will Give You Special Personal Training at Home.

Only a Limited Number of Students Can Secure My Special Instruction —ACT NOW.

CHIEF ENGINEER
Your Instructor

Qu

ST
My
Cor
cati
Fit
Tin
to

Earn

Righ
I Wi
in Q
trica

MY OFFER TO YOU:

If you act quick I will accept you among a few more students to complete
forming. Grasp this wonderful opportunity. Fit yourself by a few montl
Training to be a REGULAR CERTIFICATED ELECTRICIAN.
I have a splendidly attractive proposition for you. I GUARANTEE you sat
study of this great profession. Decide to enter it while you can do so on terr
advantageous to you. Plan a glorious future. Secure for yourself the assi
pendence, the handsome income, the agreeable working conditions, the easy
sional hours and the unlimited opportunities of trained and experienced Electrici

FREE ELECTRICAL OUTFIT

For the next 30 days I am giving each student an Outfit of Electrical Testing Instruments, Tools, Electrical materials and Motor absolutely Free. My instruction is by practical methods and this outfit is used in working out the lessons. Practical training with the theory makes perfect. I am Chief Engineer of the Chicago Engineering Works, and I can give you the training that will land the big jobs and hold them. I haven't the space here to tell you all the advantages, benefits and privileges GUARANTEED to my students. If you are ambitious to make a big success in the greatest profession on earth—if you are ready to start right in and study Electricity the "easy" way—at home—mail me the FREE "OUTFIT" coupon without delay. I will send you full particulars of my personal instruction plan, my splendid laboratory and educational facilities, my wonderfully complete and fascinating course of bed-rock lessons, and my thoroughly practical method of making Electricity easy to understand and master. Write me NOW.

L. L. COOKE

CHIEF ENGINEER

Chicago Engineering Works

Dept. 36, 441 Cass Street, CHICAGO, ILL.

USE THIS FREE "OUT

I

NAME ....

....

ADDRESS........................

TOWN..............................S

ECTRICAL GUIDES

Pay

CITY

HAWKINS ELEC

are a necessity in the da trician, Mechanic, Enginee

The set contains ten wonderfully helpful and practical volumes—written in clear concise language—easy to understand—no wasted words—full of up-to-the-minute electrical knowledge which you can apply to the problems that come up.

Just think how much these books will help you. In Hawkins Electrical Guides you always have at hand for immediate reference or study, a wonderful work containing 4,700 illustrations and 3,500 pages which cover all the subjects, principles, theories, practices, problems, troubles and ways of doing things electrically. All subjects are indexed so that you can find the information instantly. Written in the modern question and answer form. It's like having a famous electrical authority always at your elbow ready to answer any question you ask.

$1 A NUMBER—$1 A MONTH

You need specialized knowledge today if you are to master electrical forces and command the high salary of an electrical expert. Success in electricity will come through your ability to acquire and use the specialized knowledge of others—knowledge collected and condensed in Hawkins Electrical Guides.

Owners of Hawkins Electrical Guides never "get stuck." They never have to guess. They never have to waste hours trying to "dope out" electrical problems. They have the information they need right at their fingers' ends.

3,500 Pages—4,700 Pictures
Pocket-size—Flexible Covers

The Guides fit your pocket. You can carry a number about with you till you have mastered its contents. Bound with flexible covers, gold title and edges, they are truly *beautiful* books. Well printed in large type on high grade paper they are a *pleasure* to study and possess.

MEN WANTED

H. J. RAHE,
President.

TO LEARN

MOTOR MECHANICS

To fill constant demand for trained men in all branches of the Automobile, Tractor, Motor Truck and Farm Power business. On account of labor shortage, opportunities never so great as now!

LEARN EASILY AND QUICKLY IN

RAHE'S PRACTICAL SCHOOL

—by daily work on real Autos, Motor Trucks, Tractors and Gas Engines, of all standard types.
—Enormous equipment and scores of Master Mechanic Instructors make sure you will get what you come for.
—This school refers you to numerous Successful Graduates, right from your own section of the country.
—No "extras" of any kind here—only additional cost to take your course at Rahe's School is difference in car fare

Special to Drafted Men

Secretary of War says trained men "will be given mechanical opportunities." My "War Certificate" has enabled scores of men to pass into Motor Divisions for service behind the lines.

Write Today for 7-Day Trial Offer and Big 84-Page Book FREE
Also give age and present occupation.

RAHE'S AUTO & TRACTOR SCHOOL
"Greatest in the World"
2882 Oak Street,
KANSAS CITY, MO.

MEN

WOMEN

Amazing Profits

Anybody can increase their income $15 to $40 weekly raising Mushrooms at home, in cellars, barns, boxes, sheds, etc. I tell you where to sell at highest prices. Free Illustrated Booklet. Write to-day

HIRAM BARTON
Desk 3, 329 W. 48th Street, New York

ENGINEERING MECHANICAL ELECTRICAL

One Year Practical Courses. Day and Evening classes. Splendid equipment and instruction. Low tuition. For particulars address

DETROIT TECHNICAL INSTITUTE
Box 306, Y. M. C. A. Building, DETROIT, MICH.

Shipped on Approval

Write at once for particulars of shipments and

Five-Pass., 34.7 H. P. 32x3½ tires

116-in Wheelbase
Delco Ignition—Elect.

BUSH MOTOR COM

Be a

Digitized by Google

Man! Are You 1C

OR ARE you satisfied to drift along half dead—half
of those with whom you associate — overlooking
you — afraid to ackr
physical wreck? Thei
which the world has l
But perhaps you
— that you can "come
Then to you I say,
worthy of the deepes
of the confidence and

LIONEI
e world's
fect ath
ilemes
itest l

Get the
ar

the man who admits he has phy
honesty, but he must not stop t
and attention, and to do this h
condition, that he is **able** to re
desires—**go to a man** who pra
self up first. I experimented wi
what those competent to judg
the human form, according t
caused your present unfitness
unfit condition. **I will rebuil**
but a Man—**a 100% man.** I
no medicines, no fads of an
method of living, and I guar
won't undertake what I cann

The Strongfo

will in no way interfere with
calling no matter what that ca
structions will not interfere w
more, you can follow to the lett
without the knowledge of any

Now Be

Get in line with the men wort
right down and write me fully
and believe me I will tell you f
you can honestly face the wo
around your fireside, you can
to bring them into the world
manly men; women look up t
Did you ever see a thin ema
his wrist were broken Did y
busy—do not delay one s
obligate yourself to accept my
instructions, while on the other
hand I will give you solid, fear-
less advice that will be many
times worth the few minutes
it took you to write me.
Without another moment's
hesitation cross the free con-
sultation coupon herewith op-
posite what you consider to
be your main ailment, and
mail with you name and ad-
dress written plainly there-
on. You will hear from me
at once and you will hear
something well worth while.

Get this Book
's Free!

end me six cents
over mailing ex
forward free m
motion an
n of Health
d Mental En
should not b
contains man
and helpful hint

LIC R RT

P ark, N. J.

please menti

F ALL AGES

of them advanced in years, have made successful fresh
lves under the competent direction of the teaching staff
ears the very mention of the New York Electrical School has meant without further explanation all that is best in trade training. For this reason the N. Y. E. S. stands alone in its world-wide fame as the only school that has made new men out of old.

The N. Y. Electrical School is an institution wherein the manifold branches of Electrical Industry are taught through ACTUAL PRACTICE. And the only way to master a task is to do it yourself and by doing it learn to do it perfectly.

Necessarily man has also to learn the reason behind the various problems and processes, because the man of practice and no theory or the theoretical man without practice is only half a man from the point of value to himself or to an employer.

A learner at the N. Y. E. S. does not have to finish within any stated period, as there is NO TIME LIMIT to the Course. At this School it costs no more to take one's time, and men advanced in years need have no fear of being hurried by the younger and more nimble-minded.

There are no "classes." Every "learner" goes ahead as fast as he shows proficiency, and graduates just *as soon as he has proved by what he has done* that he knows how to do it! That's why this school—this actual-practice-electrical-workshop is in such high standing in the educational world.

OPEN ALL SUMMER

The New York Electrical School

40 West 17th St. NEW YORK

S'
K!

UT IT!

d, written,
M they can
Kings and
t men and
rn to their
ay furnish
your own
l mine of
handsome
names into

Learn to Write

BEGIN TODAY

WRITE FOR MY FREE BOOK

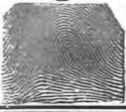
I can make a good penman of you at home during spare time. Write for my free book, "How to Become a Good Penman." It contains specimens and tells how others mastered penmanship by the Tamblyn System. Your name will be elegantly written on a card if you enclose stamp to pay postage.

FREE BOOK

Write for it Today

F. W. Tamblyn, 437 Meyer Bldg., Kansas City, U. S. A.

Finger Print Experts



EARN $25-$50 week. Interesting, Fascinating and Influential Profession. Police Depts, Factories, Industries, Banks, Capitalists, Detectives, Government Depts., identify with this system. Learn in Spare-Time study at Home. FREE—Send for SAMPLE LESSON. Reduced Tuition Rates.

SCHOOL OF FINGER PRINTING
600 Tremont St., Boston, Mass.

WAR CONDITIONS DEMAND ELECTRICAL

men with training. Having trained over 2000 young men, The Bliss Electrical School, with its well-equipped shops and laboratories, is peculiarly qualified to give a condensed course in Electrical

ENGINEERING

with Mathematics, Steam and Gas Engines, Mechanical Drawing, Shop Work, and Theoretical and Practical Electricity. Students construct dynamos, install wiring and test electrical machinery. Course, with diploma, complete

IN ONE YEAR

For practical young men with limited time. 26th year opens Sept. 25th. Catalogue on request. 102 Takoma Ave., Washington, D. C.

Google

This Coupon

Will Bring You

These Books

T
mobil
withou
—stud
your c
trial—i
out th
If you
reduce
week.
rising
won't
low pr

All About Auto

No car owner, chauffeur, garage owner or repa
of **Automobile Engineering.** It is just off
questions on the repairing of all types of pleasu
volumes are devoted to ignition, starting and lig
and public garage equipment and operation are tho
5¾ x 8½ inches, flexibly bound in genuine morocco, gold stam
etc., that make difficult points as simple as A-B-C. Written
cross-indexed for quick reference.

What the Books Cover

Explosion Motors, Welding, Motor Construction and Repair, Carbureters and Settings, Valves, Cooling, Lubrication, Fly-Wheels, Clutch, Transmission, Final Drive, Steering, Frames, Tires, Vulcanizing, Ignition, Starting and Lighting Systems, Wiring Diagrams, Shop Kinks, Commercial Garage Design, Equipment and Operation, Electrics, Storage Batteries, Care and Repair, Motorcycles, Commercial Trucks, Glossary.

Send N

Shipped for 7

Remember, you don't h
the coupon and the books
charges collect. If they fai
them at our expense. If you keep
thereafter until the rock-bottom in
less than the regular price of $25 0

Year's Consu

With each set we give
Membership. The regular
set. Put your perplexing p
Ask them as many motor q
Your name and address on the
seven days' trial. This offer is ope
States and Canada. Act quick—w

AMERICAN TECHN

F ALL AGES

of them advanced in years, have made successful fresh lves under the competent direction of the teaching staff ears the very mention of the New York Electrical School has meant without further explanation all that is best in trade training. For this reason the N. Y. E. S. stands alone in its world-wide fame as the only school that has made new men out of old.

The N. Y. Electrical School is an institution wherein the manifold branches of Electrical Industry are taught through ACTUAL PRACTICE. And the only way to master a task is to do it yourself and by doing it learn to do it perfectly.

Necessarily man has also to learn the reason behind the various problems and processes, because the man of practice and no theory or the theoretical man without practice is only half a man from the point of value to himself or to an employer.

A learner at the N. Y. E. S. does not have to finish within any stated period, as there is NO TIME LIMIT to the Course. At this School it costs no more to take one's time, and men advanced in years need have no fear of being hurried by the younger and more nimble-minded.

There are no "classes." Every "learner" goes ahead as fast as he shows proficiency, and graduates just *as soon as he has proved by what he has done* that he knows how to do it! That's why this school—this actual-practice-electrical-workshop is in such high standing in the educational world.

OPEN ALL SUMMER

The New York Electrical School

40 West 17th St. NEW YORK

S'

K!

OUT IT!

d. written,
M they can
Kings and
t men and
rn to their
ay furnish
your own
l mine of
handsome
names into

Learn to Write

BEGIN TODAY WRITE FOR MY FREE BOOK

I can make a good penman of you at home during spare time. Write for my free book, "How to Become a Good Penman." It contains specimens and tells how others mastered penmanship by the Tamblyn System. Your name will be elegantly written on a card if you enclose stamp to pay postage.

FREE *Write for it Today* BOOK

F. W. Tamblyn, 437 Meyer Bldg., Kansas City, U. S. A.

Finger Print Experts

EARN $25-$50 week. Interesting, Fascinating and Influential Profession. Police Depts., Factories, Industries, Banks, Capitalists, Detectives, Government Depts., identify with this system. Learn in Spare-Time Study at Home. FREE—Send for SAMPLE LESSON. Reduced Tuition Rates.

SCHOOL OF FINGER PRINTING
600 Tremont St., Boston, Mass.

WAR CONDITIONS DEMAND ELECTRICAL

men with training. Having trained over 2000 young men, **The Bliss Electrical School,** with its well-equipped shops and laboratories, is peculiarly qualified to give a **condensed course** in Electrical

ENGINEERING

with Mathematics, Steam and Gas Engines, Mechanical Drawing, Shop Work, and Theoretical and Practical Electricity. Students construct dynamos, install wiring and test electrical machinery. Course, with diploma, complete

IN ONE YEAR

For practical young men with limited time. 26th year opens Sept. 25th. Catalogue on request. 102 Takoma Ave., Washington, D. C.

Who will write the SONG-HIT OF THE WAR?

With this country entering its second year in the "World War" it is doubtful if the song which will be known as the "Hit of the War," has as yet made its appearance. While it is true that such War Songs as "Over There" and "Liberty Bell" have made some impression, have Our Boys adopted another "It's a Long Way To Tipperary," which has been the great favorite with the "English Tommies"? Inasmuch as several Commanders of our training cantonments have requested boys in the service to write such a song it appears to be still wanting.

Have you an idea which you think might be used as the subject for a Patriotic or War Song? If so, you may secure some valuable information and assistance by writing for a Free Copy of our new booklet entitled **"SONG WRITERS' MANUAL AND GUIDE."** We revise song-poems, compose and arrange music, secure copyright and facilitate free publication or outright sale.

Poems submitted examined FREE.

KNICKERBOCKER STUDIOS 88 GAIETY BLDG., N. Y. C.

GOV'T JOBS

Short hours. Easy work. No strikes. No hard times. Steady, lifetime positions, $75 to $150 a month to start. Quick promotion.

MEN WANTED! If you are an American Citizen 18 or over write for FREE book that tells about these and many other wonderful advantages offered by U. S. Government. Railway Mail, Post Office, Custom House, Panama Canal and other divisions. Prepare under former Civil Service Secretary-Examiner. You can qualify. Write for FREE BOOK and Special 20 Day Offer NOW.

PATTERSON CIVIL SERVICE SCHOOL, 166 News Bldg., Rochester, N. Y.

BOOKKEEPING IN 30 DAYS

Learn at Home. Earn Big Money.

Become an expert through amazing New Method of training. Nothing like it. Hundreds successful in big paying positions. **Easy to learn. Guaranteed. Money refunded if you fail.** Write at once for Free illustrated catalog, Letters of proof and Special Offer. Address

Garvin Institute, Dept 58-61, 751-755 WOODWARD AVE., **Detroit, Mich.**

I TEACH Penmanship BY MAIL

I won the **World's First Prize for best course in Penmanship.** Under my guidance you can become an expert penman. Am placing many of my students as instructors in commercial colleges at high salaries. If you wish to become a better penman, write me. I will send you FREE one of my **Favorite Pens** and a copy of the Ransomerian Journal. Write me today. Address

C. W. RANSOM, 340 Essex Bldg., Kansas City, Mo.

Be an Artist

Comics, cartoons, commercial, newspaper and magazine illustrating. Pastel crayon portraits and Fashions. **Earn $25 to $200 a week.** By our simple method your talent is quickly developed without interfering with present work. **By Mail or Local Classes. The largest practical art School in the world.** Write for full particulars and list of successful pupils, illustrated prospectus, etc. Endorsed by newspapers and magazines.

ASSOCIATED ART STUDIOS, 58D, Flatiron Building, New York, N. Y

Electrical Meter Engineering

"The Profession With a Future"

Now learned at home. Big demand for competent men. Pleasant, interesting, fascinating employment all the year 'round, with exceptional opportunities for advancement. Success guaranteed. High salaries offered. No experience necessary.

Special Offer! In order to get more men to train for good positions, we are making a great special offer to a limited number. Write today for full particulars—FREE. No obligations. Be a Meter Engineer, the man who fires: not the one who is fired. Be boss. Write today.

Fort Wayne Correspondence School
Dept. 1206 **Fort Wayne, Indiana**

Digitized by Google

image
not
available

Learn Electricity

EARN $100 TO $400 PER MONTH

In the electrical business, thousands of skilled electricians needed in Government service and at home. The need is growing greater every day and enormous salaries are paid. Right *now* is your big opportunity. Come to COYNE and let experts train you in our $93,000.00 shops. Train you to be a master Electrician. We assist you to a position after graduating. We have more positions than we can fill

COYNE TRADE AND ENGINEERING SCHOOLS

Teach You in Short Time at Small Expense. Start right now—anytime, finish in three to four months. Students live in comfortable homes in most beautiful part of city—on the Lake. Many students earn a large part of their living expenses by working a little in their spare time. Our employment dep't furnishes these positions without charge.

SPECIAL 5 WEEKS COURSE FOR DRAFTED MEN

Drafted men, you will soon be called into service. Uncle Sam needs tens of thousands of men skilled in modern trades such as Electricity, Drafting, Plumbing and Sanitation. Such men will be given an opportunity to rise. Come at once and fit yourself for promotion. You take no chances. We give you this course at half price and refund all your money if you are sent to camp before you finish. But you'll have to act quickly for we can only take a limited number.

DRAFTING—PLUMBING MOTION PICTURE OPERATING

Taught thoroughly, quickly and practically by masters right in our big shops—big demand for our graduates—we have more positions than we can fill

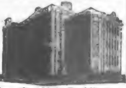
WRITE NOW

Send now for our big free book of practical information. Be sure and mention the trade you are interested in. This is important.

Bennett Wellington Cooke, Dir.,

Coyne Trade and Engineering Schools,

39-51 E. Illinois St.
Dept. 140-X Chicago, Ill.



Our Main Building

New Book Free

Write today for the book that tells about the opportunities in the profession of Signal Engineering. Men are needed. Learn, too, how you can get the training that you need to fill the big job.

$125 to $300 a Month

The free book will give you just the information you want. Write for it now—immediately. Here is a golden opportunity.

Dept. of Signaling Dept.A-120-1810 Wilson Ave. Ravenswood Sta., Chicago, Ill.

Music Lessons

Book Sent FREE Wonderful home-study music lessons under great American and European teachers given by the University Extension Method. The lessons are a marvel of simplicity and completeness. Anyone can learn at home. Endorsed by Paderewski and many other great authorities.

Any Instrument or Voice

Write, telling us the course you are interested in, age, how long you have taken lessons, if at all, etc., and we will send you our Free Book containing text and illustrations covering Lessons in PIANO (students' or teachers' courses) by the great Wm. H. Sherwood, HARMONY by Dr. Protheroe and Rosenbecker, VOICE COURSE (with aid of Phonograph) by Crampton, PUBLIC SCHOOL MUSIC by Frances E. Clark, VIOLIN, CORNET, MANDOLIN, GUITAR, BANJO, REED ORGAN, by equally eminent teachers.

Send NOW for Free Book and learn how easily you can become a fine singer, or a skillful player. Write today for full particulars. Investigate without cost or obligation.

University Extension Conservatory 3996 Siegel-Myers Bldg., Chicago

BE AN EXPER
ACCOUNTA

Better your position in business. The Home Study Course in Higher Accounta prepare you in **a new profession** of spler portunities.

There are only 2000 Certified Public Accountants in Yet there are over **half a million** firms that require th of these expert business analysts. The field is truly u the **demand** always greater than the supply of profic That shows where opportunity is. Write for inf about the Course in Higher Accounting given b Extension University.

Learn By Mail

With our training you can readily qualify for th of Auditor, Certified Public Accountant, Comptr Many expert accountants earn $3,000 to $10,000 annu

Small Cost—Easy Tern

Our course and service is under the supervision of a lar C. P. A.'s, including William B. Castenholz, A. M., C. P. Comptroller and Instructor, University of Illinois; Wm. Art LL. M., C. P. A., Ex-Secretary Illinois State Board of Ac and other members of American Institute of Accountants.

We prepare you from the ground up at small cost a terms—provide complete and comprehensive training accordi individual needs, from the simplest bookkeeping principles advanced accounting problems. We will give you whateve instruction or review on the subject of bookkeeping you may need—and without any extra expense to you.

Free Consulting Servic

As a La Salle student you will have the privilege of ca our staff of experts in any department whenever you need or counsel. No other institution of similar character gives yo like this.

The LaSalle Guarante

We will give you a written guarantee that should you f the Certified Public Accountant's examination held in any sta give you special instruction and help—without additional ch you do pass. We further agree to refund entire amount of cording to our Guarantee Bond if dissatisfied upon completion

Our free book tells the whole story. Explains state ex and regulations, salaries paid expert accountants, etc.—also plete information regarding the Course and Consulting serv the first step toward greater success by mailing the coupon tod

— — — FREE BOOK COUPON —

LASALLE EXTENSION UNIVER

"The World's Greatest Extension University"

Dept. 683-H Chicago, Illi

Send at once, without cost or obligation to me, your val of accounting facts and full details of your course in Highe ancy.

Name ....

Present Position ....

Address ....

When writing to Advertisers please mention Popular Science Monthly

image
not
available

QUICK-ACTION ADVE

HERE OUR READERS AND ADVERTISERS MEET T(

RATE 20 CENTS A WORD. Remittance in the form of currenc
MUST ACCOMPANY THE COPY. The July issue

AUTOMOBILES AND ACCESSORIES

"HYDRONIZER—Insures clean plugs, consumes carbon, saves gasoline, saves repairs and is easy to sell. Money back guarantee. Fits all cars. Fords do 34 miles to gallon. Thousands in use. Have attractive proposition for energetic and responsible agents, also unique advertising. Agents' price permits wholesaling and retailing. Write for free literature. Friestedt Manufacturing Company, 2933 W. Lake St., Chicago, Illinois

ANYONE can quickly apply our transfer initials and emblems on automobiles, etc. Enormous profit. Samples free. Globe Decalcomanie, Jersey City, N. J.

INVENTIONS developed. Expert advice, drawings, calculations, experimental and model work. Automotive Engineering Company, Castle Hall Building, Indianapolis, Ind.

MOTOR HY-LIFE, "The National Gasoline Saver" rids motor of carbon. Increases, by actual test, mileage 30%. Energizes either gasoline or kerosene. Used everywhere in Automobiles, Trucks and Tractors. One dollar's worth prepaid to you proves our claim. Send today. Arehart Chemical Co., Dept. 4, Rosholt, South Dakota.

GET the Power! "Carbonal" Kills Carbon, Saves Gasoline, Increases Mileage. $1.00 Box treats 100 Gallons Gasoline, Saves $6.00. Order today—money back if not satisfied. Agents making good. Carbonal Products Company, Ruston, Louisiana.

WE WRITE Business-Building Letters. Advertisements, Circulars and Booklets, at attractive rates. Results guaranteed. What is Your problem? Criterion Service, Dep't 1, West New York, New Jersey.

CONVERT your bicycle into a motorcycle at small cost by using Shaw Motor Attachment. Catalog free. Shaw Mfg. Co., Dept. 180, Galesburg, Kansas.

DIMMERS, Williams' dimmer quickly attached to any car. Simple, efficient. Per Set, $2.00. Agents wanted. Write Fisher Mfg. Co., 2183H, Railway Exchange, St. Louis, Mo.

BATTERY Charging pays big profits. City currents or gas engine operates. Easy terms. Hoberts, Troy, Ohio.

POWER increased; carbon eliminated; results guaranteed. Read our offer on page 126. Automobile Accessories Company, Baltimore, Maryland.

DOUBLE Service Tires—almost puncture proof. Sizes 30x3, $5.50; 30x3½, $6.60; 33x4, $8.80; 34x4, $9.90; 36x4, $9.90, 36x4½, $11; 36x5, $12.10; 37x5, $12.10. Non-skid, $1.00 extra. 10% required on C.O.D. orders. State if Q.D. straight-bead or clincher type. Special discount to dealers. We also carry a full line of new tires at special prices. I. Jaffess, 1319 D 5th Avenue, New York. Branch—241 W. 54th Street.

SQUARE See Garage Air-Stations. Practical and efficient. Write for illustrations and prices. A. Campbell Iron Co., Cass Avenue, St. Louis.

PATENTS—For automobiles are in great demand. We have special Automobile Department in charge of experts who are in touch with demands of trade. Write for What to Invent and List of Patent Buyers, sent free. Victor J. Evans & Co., 172 Ninth, Washington, D. C.

IF You want to buy something, sell something, or exchange something write for my proposition. 1,500,000 people are watching these columns every month for the very thing you have to offer. Let me tell you how to reach them. D. W. Coutlee, 225 West 39th Street, New York City.

AUTO Specials: Ward Leonard Generators $8.00, Gray and Davis-Electric head lamps with dimmers $4.50, Ford engine air pump—complete all fittings—$3.00, Bosch magnetos, 4 & 6 cylinder, $10.00. Auto Motors, 4 cylinder, water cooled, $30.00., Buick 10-17, Mitchell, Everett, Hupp 20, Continental and Buda Motors. All sizes and types. Guaranteed. Write for special Bargain Bulletin No. 85. Johnston, West End, Pittsburgh, Pa.

VULCANIZING Auto Tires is a growing business. Our plants are easy to learn to operate. Catalog is free. You save 30%. Instruction book on vulcanizing 75c. Equipment Co., 302 Eighth St., Cincinnati, Ohio.

SLEEP in your Ford in McMillin Auto Bed, $10.00. Other small cars $12.50. Free booklet on auto camping. Auto Bed Company, Dept. 3, Bellingham, Washington.

Popular Science Monthly,
New York City.
Gentlemen:

Since we have been using your magazine to advertise our service, the results obtained far exceed our expectations.

All of our advertisements placed in about twenty-five national class and trade magazines are keyed and an accurate record kept of results. Our records show the cost per inquiry from Popular Science Monthly is exceptionally low and they are from readers of high intelligence. The sales average is higher than any other publication used.

Yours very truly,
QUADRI COMPANY.

TIRES—Double Tread Guaranteed for good service. Absolutely Puncture-Proof. Big—Strong—Extra, heavy 30x3 tire, $5.25; 30x3½, $6.50; 33x4, $9.25; 34x4, $9.50; 36x4½, $12.00; 37x5, $13.00. Big saving on other sizes and tubes also. Trade in your old tires. Discount to dealers. 10% deposit required on C. O. D. orders. Send for list now! State size and bead of tire. Max Liben & Co., 205P West 48th Street, New York.

TIRES At Wholesale—Send For Prices on guaranteed tires and tubes. Lowest prices on earth. Overton Tire Co., Box P, Oelwein, Iowa.

"GAS-SOL" gives you 15 to 40% more mileage and eliminates carbon. Money back Guarantee. 100 tablets treat one hundred gallons gasoline. Price One Dollar. Live Agents wanted. Gas-Sol, Dept. B, Wakefield, Mass.

"QUICK-ACTION Advertising—How it is Building Business for the Progressive Advertisers of America." A little story of Results, told by the advertisers themselves—not the publisher. You will be interested in reading the little booklet we have prepared, a copy of which will be gladly sent upon request. It may solve YOUR problem. D. W. Coutlee, Classified Department, Popular Science Monthly, 225 West Thirty-ninth Street, New York.

AVIATION

AIRPLANE INSTRUCTION. Get out the rut. Enter a profession that offers ou the biggest future. Our course in practi- l airplane construction will prepare you for e greatest and best paid profession of the ge. Civil and government positions open. len prepared for service in the Signal orps, U. S. Army. Day and evening asses. Write for booklet "S" U. S. Aero, Park Row, New York City.

MEN—Learn Flying, Aeroplane Building Motor work. Government or exhibition. Vinter and Summer field. Write—Moler viation Instructors, Pablo Beach, Jackson- ile, Florida, or Chicago, Illinois.

WORLD-ROMIC System, Masterkey to l languages. Six textbooks, $1.44. French art, 37c; Spanish, 37c. Aviation diction- y, $1.50. Languages, 143 West 47th St., ew York.

PATENTS wanted in Aeronautics. U. S. overnment spending millions in this class r Army and Navy. Our Aeronautic De- rtment will give full information on this bject upon inquiry. Write for What to vent, sent free. Victor J. Evans & Co., 9 Ninth, Washington, D. C.

THE AMERICAN School of Aviation nounces a new correspondence course in echanics of Aviation. A thorough training Practical Aeronautics. American School Aviation, Dept. 7596, 431 So. Dearborn reet, Chicago.

FOR ADVERTISERS

WE WRITE Business-Building Letters, lvertisements, Circulars and Booklets, attractive rates. Results guaranteed. hat is Your Problem? Criterion Service, ep't. 1, West New York, New Jersey.

SPECIAL! Inch display advertisement 0 magazines, thrice, $8.00. Universal ndicate, Atlantic City.

TWENTY Word Advertisement in 100 onthlies for $1.00. Thrice $2.00. Ameri- n System, Hollywood, California.

FOR OFFICE AND FACTORY

TIME Clocks—Cincinnati Clocks, No. 5's tstkeepers. International and Bundy— mplex button and card machines. Key corders and autographs. Dial clocks. The ggest second-hand place in the U. S. with anches in seventeen large cities. Consult ur telephone directory or write the Second and Department of The Cincinnati Time ecorder Co., Cincinnati, Ohio.

DEALERS Get Our Samples and Prices. alter Bogue Pen Co., 1529 Elmwood Ave., eveland, Ohio.

ADDING MACHINES

SAVES Time, Money, Labor—costs less an the average mistake. The Ray adds th speed and accuracy of highest priced achines. Used by U. S. Government, In- rnational Harvester Co., B. & O. Ry., siness and professional men everywhere. mplete for $25. Send no money, but ite for 20 day free trial. Ray Company, 85 Candler Bldg., New York.

LETTER SPECIALISTS

Letters, advertising literature, ... toasts, etc., written ... Rates reason- ... Bureau, New

... Letters, ... and Booklets, ... guaranteed. ... Service, ... Jersey

...TIONS

... Delaware, ... Service guaran- ... The Corpora- ... Building, 111

... of the wonder- ... Columns of ... to buy some- ... something, ... D. W. ... Advertising, ... 5 West 39th

TELEGRAPHY

TELEGRAPHY—Both Morse and Wireless; Station Agency, taught quickly. Tremendous Demand—greater than supply. Permanent Positions Secured—Big Salaries. Ideal Working Conditions. Great Opportunities for Advancement. Women Operators also needed. All expenses low—can earn living while attending. Oldest and largest school—established 44 years. Endorsed by Railway, Western Union and Marconi officials. Now offering special three months' Radio course for young men subject to draft, enabling them to enter Signal Corps—"Preferred Service." Large illustrated catalogue free. Correspondence courses also. Write today. Enroll Immediately. Dodge's Institute, 16th St., Valparaiso, Indiana.

TYPEWRITERS AND SUPPLIES

LARGEST stock of Typewriters in America. Underwoods, less than 40% manufacturer's prices. Rented anywhere, applying rent on purchase price; free trial. Instalment payments if desired. Write for catalogue 11. Typewriter Emporium (Estab. 1892). 34-36 West Lake Street, Chicago, Illinois.

GOOD Serviceable Typewriters $10 and up. Post card brings list. First-class ribbons, any standard machine 35c. Hub Typewriter Co., 286 Devonshire St., Boston.

NEW, rebuilt and slightly used Typewriters $8 up. Portable Machines $10 up. Write for our Catalog 25V Beran Typewriter Co., 58 W. Washington St., Chicago.

UNDERWOODS, Olivers. Royals, Remingtons, $15 to $45; rebuilt: guaranteed free trial. Typewriter Co., 193 N. Dearborn, Chicago.

COLLECTIONS AND ADJUSTMENTS

COLLECTIONS everywhere. Promptness our watchword. Phoenix Mercantile Bureau, Omaha, Nebraska.

DEBTS collected quickly! Established 25 years. William H. Dodd, 87 Nassau St., New York.

MODELS AND MODEL SUPPLIES

We carry a complete line of brass gears and model supplies. Send for catalogue. The Pierce Model Works, 3495 Pierce Ave., Chicago, Ill.

WANTED—New Ideas. Write for list of Patent Buyers and Inventors Wanted. $1,000,000 in prizes offered for inventions. Our Four Books sent free upon request. Victor J. Evans & Co., 176 Ninth, Washington, D. C.

INVENTORS: For perfect models and dies at low prices, write Fisher Mfg. Co., 2183E, Railway Exchange, St. Louis, Mo.

MOTORS, ENGINES AND MACHINERY

WESTINGHOUSE, Wagner, Fort Wayne, Holtzer-Cabot, Emerson, Crocker Wheeler, General Electric rebuilt motors guaranteed for one year. Alternating and direct current. All sizes from 1-30 horsepower upwards. Tell us your needs. Satisfaction guaranteed or money refunded. Sned for illustrated price list supplies and motors. Hyre Electric Co., 629 GH South Dearborn St., Chicago.

SMALL Motors and Generators: ¼ H.P. A.C. Motors $17.50—½ H.P. $35.00. Battery Charging Sets: 100 new machines just received $30.00 each. Charging Lighting and Moving Picture Arc Generators, $10.00 each and up. A.C. Motors 1 and 3 phase up to 5 H.P. for immediate delivery. All material guaranteed new, less than ½ price. Write for new bulletin. Johnston, West End, Pittsburgh, Pa.

A BARGAIN, New Robbins & Myers Motors. 1—10 H. P., 110 Volt, 8000 RPM Universal. Not a toy. $9.00 each. Doubleday-Hill Elec. Co., Pittsburgh, Pa.

500 SMALL Electric Motors—110 Volts AC—¼-H.P. $16.50—vacuum Cleaners—Irons—etc. Everything Brand New—Never Unpacked — Guaranteed Perfect—Priced Lower than Manufacturers Cost—Send for Money Saving List. Lincoln Supply Co., Ephrata, Pennsylvania.

SMALL Power Gas Engine, to run all kinds of small Machinery, Pumps, Washing Machines, Cream Separators, etc. Combination Counter Shaft and Starter. Self-lubricating and cooling. Direct from factory. Satisfaction guaranteed or money refunded. Circular free. Universal Gas Motor Co., 364 Monadnock Block, Chicago.

Digitized by Google

PRINTING, ENGRAVING AND MULTIGRAPHING

GOOD Printing at low prices; 1,000 good letterheads, envelopes, cards, billheads, labels, circulars, $2.50; samples free; catalogues, booklets and circulars our specialty. Ernest L. Fantus Co., 523 S. Dearborn St., Chicago, Ill.

EMBOSSED Stationery—Trifle more than Common. Samples. Commercial Embossing Company, Wilkes-Barre, Penn.

GUMMED Labels and Advertising Stickers Free. 3,000 75c upwards. Royal Label Company, 414 Cherry, Philadelphia.

100 6¾ envelopes printed to order, 65c prepaid. Samples. Lincoln Novelty Co., Rochester, N. Y.

50 Classy Calling Cards and patented card case 25c. Extra grade, Linen, 35c. Samples. Retter, 302 Fourth, Tippecanoe City, Ohio.

"QUICK-ACTION Advertising—How, it is Building Business for the Progressive Advertisers of America." A little story of Results, told by the advertisers themselves—not the publishers. You will be interested in reading the little booklet we have prepared, a copy of which will be gladly sent upon request. It may solve YOUR problem. D. W. Coutlee, Classified Department Popular Science Monthly, 225 West Thirty-ninth Street, New York.

SPECIAL beginners' outfit; 100 letterheads, 100 envelopes, 100 return envelopes, all for $2.00. Ross H. Kelly, 342 Batavia, Toledo, Ohio.

AT Last! Beautiful Lithography for small users. 1,000 Letterheads, 1,000 Billheads and 1,000 Statements $9.90. Kaydee Lithographing Co., 772 Teutonia, Milwaukee.

SERVICEABLE Pre-Used Printing Presses, Type, Supplies. Lowest prices, List for stamp. P.S. Bargains, Richland, Pennsylvania.

125 Letterheads or Envelopes, 50c. prepaid. Printer-Laborde, Mansura, Louisiana.

MULTIGRAPHING, Mimeographing, Typewriting, Office Services, Business Service Corporation, Washington, D. C.

200 Bond Letterheads, Prepaid, $1. Southwestern, 1413-B Berendo, Los Angeles.

1000 Letterheads, $2.50; 5000, $10. Copper Journal, Hancock, Michigan.

ELECTRICAL

INVENT Something. Your ideas may bring wealth. Send postal for Free book. Tells what to invent and how to obtain a patent through our credit system. Talbert & Talbert, 4675 Talbert Building, Washington, D. C.

ILLUSTRATED catalog, just issued. Electrical supplies and motors, wire, switches loom, plugs, tape, rosettes, lamps, fuses, sockets. Send for free copy today. Hyre Electric Co., 629 WN South Dearborn St., Chicago.

100 INDUCTION Motor Winding Diagrams: 1, 2, 3 phase; Star Delta, 2 to 12 doles inclusive. Postpaid, $5.00. E. Glass, 2819 East 8th Street, Kansas City, Missouri.

MAKE Dry Batteries. Simple, practical instructions with blue print, 25 cents. Dirigo Sales Company, Bath, Maine.

WE WRITE Business-Building Letters, Advertisements, Circulars and Booklets, at attractive rates. Results guaranteed. What is Your problem? Criterion Service, Dep't. 1, West New York, New Jersey.

READERS of Popular Science Monthly—here's your chance: We have on hand 200 copies of bound volume No. 88—January to June 1916; 25 copies of volume No. 89—July to December 1916; 25 copies volume No. 90—January to June 1917 and 500 copies of volume No. 91—July to December 1917. These copies are beautifully bound in heavy gray covers with dark green backings, containing the words "Popular Science Monthly," the volume number and months included. Each volume comprises 960 pages, 1,306 articles and 2,082 pictures. Just the thing for your library. A ten page index enables you to find in a moment any article or picture desired. Contain no advertising whatever. At the present cost of printed matter, these volumes should retail at $5.00. You can secure them now for $3.00 each postpaid. Classified Department, Popular Science Monthly, 225 West Thirty-ninth Street, New York City.

CAMERAS, PHOTOGRAPHY, SUPPLIES

FILMS Developed, 10c, all sizes. Prints 2¼ x 3¼, 3c; 4¼ x 4¼, 4c. We give Profit Sharing Coupons. 24 hour service, work guaranteed. Send negative for samples. Girard's Com. Photo Shop, 316 High St., Mills Alderman Bldg., Holyoke, Mass.

AMATEUR Photographer's Weekly—the Journal That Teaches How. Special—3 months (13 issues) for 25c stamps or coin. Established 1912. 403 Caxton Building, Cleveland, Ohio.

FILMS Developed, Printed and Enlarged by our new system are the best ever. Prompt, low-priced, perfect. Just send your name for full details. Sample roll developed, 10 cents. Roanoke Photo Finishing Co., 212 Bell Ave., Roanoke, Va.

FILMS Developed 5c. Prints 3c. Photocraft, Box 69, Ann Arbor, Michigan.

HUNDREDS of bargains in slightly used Graflex Kodaks, Cameras and Lenses. Equal to new; Fully Guaranteed; 25% to 60% saving. We sell on 10 day free trial. You take no chances. 18 years in business. Send for Our Free Bargain Book and Catalog. Central Camera Co. Dept. 55-A, 124 So. Wabash Ave., Chicago.

INVENTIONS—Wanted in Motion Pictures and Photography. Special Department for these classes of invention. Advice, What to Invent and List of Patent Buyers sent free. Victor J. Evans & Co., 173 Ninth, Washington, D. C.

BEST developing, printing in country. Send 3c for circulars or 15c and roll for sample developing, printing. Rare bargains used cameras. Miles P. Greenwood, Melrose, Massachusetts.

Clean Neat Finishing. Postage paid both ways. Mailing boxes furnished. Get prices and samples. C. Grant Myers, Department One, Summit, New Jersey.

FOR BOYS

THE Boy Electrician contains practical plans for Electrical Apparatus for work and play with an explanation of the principles of every day electricity. Tells of the actual experiences of a boy who gained a practical education in electricity by making his own Static Machines, Electromagnets, Cells and Batteries, Binding Posts, Switches and Cut outs. Measuring Instruments, Induction Coils, Transformers, Motors, Dynamos Wireless Telephone, etc. 394 Pages, 350 Illustrations. Price $2.00. Book Department. Popular Science Monthly, 225 West 39th Street, New York.

FOR SALE

VACUUM Pumps, Hose and Supplies Build your own machine. Save half Vacuum Pumps & Parts Co., Box 78, Ann Arbor, Michigan.

CHOICE Silver Black breeding Foxes Reid Brothers, Bothwell, Ontario, Can.

UNIVERSAL Portable Shelf—the shelf of a thousand uses, postpaid, 60c. Agents Wanted. Attractive booklet free. George Gaylor, Clearfield, Pennsylvania.

LET me send you C. O. D. one of my high grade Razors. A regular $3.00 value. We have a limited stock which we are selling at $1.50 while they last. Send no money, order today. Dan Williams, Box 135, Odin, Ill.

FAVORITE Printing Press—will sell reasonable, 242 McLean Avenue, Yonkers New York.

FLOWERS, SEEDS AND PLANTS

GATHER Roots and Herbs. Now is the time. Book of instructions, high war prices and address of buyers only 20c. postpaid Medical Plant Company, West Milan, New Hampshire.

FRESH Flowers delivered any city by co-operative organization florists. Send order with remittance to National Floral Corporation, 221 Broadway, New York Booklet free.

EVERYMAN'S PLEDGE — America shall win this war! Therefore, I will work I will save, I will sacrifice, I will endure, I will fight—cheerfully, and do my utmost—as if the whole issue of the struggle depended on me alone.

AVIATION

AIRPLANE INSTRUCTION. Get out the rut. Enter a profession that offers ou the biggest future. Our course in practi- l airplane construction will prepare you for e greatest and best paid profession of the ge. Civil and government positions open. en prepared for service in the Signal orps, U. S. Army. Day and evening asses. Write for booklet "S" U. S. Aero, Park Row, New York City.

MEN—Learn Flying, Aeroplane Building Motor work. Government or exhibition. inter and Summer field. Write—Moler viation Instructors, Pablo Beach, Jackson- ille, Florida, or Chicago, Illinois.

WORLD-ROMIC System, Masterkey to l languages. Six textbooks, $1.44. French art, 37c; Spanish, 37c. Aviation diction- y, $1.50. Languages, 143 West 47th St., ew York.

PATENTS wanted in Aeronautics. U. S. overnment spending millions in this class r Army and Navy. Our Aeronautic De- rtment will give full information on this bject upon inquiry. Write for What to vent, sent free. Victor J. Evans & Co., 9 Ninth, Washington, D. C.

THE AMERICAN School of Aviation nounces a new correspondence course in echanics of Aviation. A thorough training Practical Aeronautics. American School Aviation, Dept. 7596, 431 So. Dearborn reet, Chicago.

FOR ADVERTISERS

WE WRITE Business-Building Letters, ivertisements, Circulars and Booklets, attractive rates. Results guaranteed. hat is Your Problem? Criterion Service, ep't. 1, West New York, New Jersey.

SPECIAL! Inch display advertisement 0 magazines, thrice, $8.00. Universal ndicate, Atlantic City.

TWENTY Word Advertisement in 100 onthlies for $1.00. Thrice $2.00. Ameri- n System, Hollywood, California.

FOR OFFICE AND FACTORY

TIME Clocks—Cincinnati Clocks, No. 5's ostkeepers. International and Bundy— mplex button and card machines. Key corders and autographs. Dial clocks. The ggest second-hand place in the U. S. with anches in seventeen large cities. Consult ur telephone directory or write the Second and Department of The Cincinnati Time ecorder Co., Cincinnati, Ohio.

DEALERS Get Our Samples and Prices. alter Bogue Pen Co., 1529 Elmwood Ave., eveland, Ohio.

ADDING MACHINES

SAVES Time, Money, Labor—costs less an the average mistake. The Ray adds th speed and accuracy of highest priced achines. Used by U. S. Government, In- rnational Harvester Co., B. & O. Ry., siness and professional men everywhere. omplete for $25. Send no money, but rite for 20 day free trial. Ray Company, 85 Candler Bldg., New York.

LETTER SPECIALISTS

SALES Letters, advertising literature, ... toasts, etc., written ... Rates reason- ... Bureau, New ...

... Business-Building Letters, ... and Booklets, ... Results guaranteed. ... Criterion Service, ... York, New Jersey.

...TIONS

... Arizona, Delaware, ... Service guaran- ... The Corpora- ... Building, 111

... of the wonder- ... Columns of ... want to buy some- ... exchange something, ... particulars. D. W. ... Advertising, ... 225 West 39th

TELEGRAPHY

TELEGRAPHY—Both Morse and Wireless; Station Agency, taught quickly. Tremendous Demand—greater than supply. Permanent Positions Secured—Big Salaries. Ideal Working Conditions. Great Opportunities for Advancement. Women Operators also needed. All expenses low—can earn living while attending. Oldest and largest school—established 44 years. Endorsed by Railway, Western Union and Marconi officials. Now offering special three months' Radio course for young men subject to draft, enabling them to enter Signal Corps —"Preferred Service." Large illustrated catalogue free. Correspondence courses also. Write today. Enroll Immediately. Dodge's Institute, 16th St., Valparaiso, Indiana.

TYPEWRITERS AND SUPPLIES

LARGEST stock of Typewriters in America. Underwoods, less than 40% manufacturer's prices. Rented anywhere, applying rent on purchase price; free trial. Instalment payments if desired. Write for catalogue 11. Typewriter Emporium (Estab. 1892). 34-36 West Lake Street, Chicago, Illinois.

GOOD Serviceable Typewriters $10 and up. Post card brings list. First-class ribbons, any standard machine 35c. Hub Typewriter Co., 286 Devonshire St., Boston.

NEW, rebuilt and slightly used Typewriters $8 up. Portable Machines $10 up. Write for our Catalog 25V Beran Typewriter Co., 58 W. Washington St., Chicago.

UNDERWOODS, Olivers, Royals, Remingtons, $15 to $45; rebuilt; guaranteed free trial. Typewriter Co., 193 N. Dearborn, Chicago.

COLLECTIONS AND ADJUSTMENTS

COLLECTIONS everywhere. Promptness our watchword. Phoenix Mercantile Bureau, Omaha, Nebraska.

DEBTS collected quickly! Established 25 years. William H. Dodd, 87 Nassau St., New York.

MODELS AND MODEL SUPPLIES

We carry a complete line of brass gears and model supplies. Send for catalogue. The Pierce Model Works, 3495 Pierce Ave., Chicago, Ill.

WANTED—New Ideas. Write for list of Patent Buyers and Inventors Wanted. $1,000,000 in prizes offered for inventions. Our Four Books sent free upon request. Victor J. Evans & Co., 176 Ninth, Washington, D. C.

INVENTORS: For perfect models and dies at low prices, write Fisher Mfg. Co., 2183E, Railway Exchange, St. Louis, Mo.

MOTORS, ENGINES AND MACHINERY

WESTINGHOUSE, Wagner, Fort Wayne, Holtzer-Cabot, Emerson, Crocker Wheeler, General Electric rebuilt motors guaranteed for one year. Alternating and direct current. All sizes from 1-30 horsepower upwards. Tell us your needs. Satisfaction guaranteed or money refunded. Sned for illustrated price list supplies and motors. Hyre Electric Co., 629 GH South Dearborn St., Chicago.

SMALL Motors and Generators: ¼ H.P. A.C. Motors $17.50— ¼ H.P. $35.00. Battery Charging Sets: 100 new machines just received $30.00 each. Charging Lighting and Moving Picture Arc Generators, $10.00 each and up. A.C. Motors 1 and 3 phase up to 5 H.P. for immediate delivery. All material guaranteed new, less than ½ price. Write for new bulletin. Johnston, West End, Pittsburgh, Pa.

A BARGAIN, New Robbins & Myers Motors. 1—10 H. P., 110 Volt, 8000 RPM Universal. Not a toy, $9.00 each. Doubleday-Hill Elec. Co., Pittsburgh, Pa.

500 SMALL Electric Motors—110 Volts AC—¼-H.P. $16.50—vacuum Cleaners—Irons—etc. Everything Brand New—Never Unpacked — Guaranteed Perfect—Priced Lower than Manufacturers Cost—Send for Money Saving List. Lincoln Supply Co., Ephrata, Pennsylvania.

SMALL Power Gas Engine, to run all kinds of small Machinery, Pumps, Washing Machines, Cream Separators, etc. Combination Counter Shaft and Starter. Self-lubricating and cooling. Direct from factory. Satisfaction guaranteed or money refunded. Circular free. Universal Gas Motor Co., 364 Monadnock Block, Chicago.

PATENTS AND PATENT ATTORNEYS

PATENTS Promptly Procured. Send Sketch or Model for Actual Search and Report, 1918 Edition. 90-Page Patent Book Free. My patent sales service gets full value for my clients. It should never require more than 2 days to report upon the patentability of your invention; nor longer than 10 days to prepare your case for filing. Longer delay amounts to gross neglect and the jeopardizing of your rights. For prompt personal service write George P. Kimmel, 38-F Oriental Building, Washington, D. C.

INVENTORS, you need my free books "Patents and Successful Promotion." Tell how your ideas can be turned into money. Honest advice free. Real personal service. Highest references. Lloyd W. Patch, 23 Le Droit Bldg., Washington, D. C.

PATENT Your Ideas. Books, "How to Obtain a Patent," and "What to Invent," sent free. Send rough sketch for free report regarding patentability. Manufacturers constantly writing us for patents. Patents advertised for sale free. Established 20 years. Address Chandlee & Chandlee, Patent Attorneys, 403 7th St., Washington, D. C.

SUCCESSFUL inventions must be patented to assure protection while being perfected. Write for a free opinion as to the patentability of your idea. Beale & Park, 1422 F Street, Washington, D. C.

C. L. PARKER, Patent Attorney, McGill Building, Washington, D. C. Inventors' hand-book, "Protecting, Exploiting and Selling Inventions," sent free upon request.

"PATENTS and Patent Possibilities" is a 72-page treatise which tells all about patents, what to invent and where to sell it. It gives honest advice to inventors and tells about the successes of some of my clients, also explaining what are frequent causes of failure. Manufacturers are constantly writing for protective patents upon all kinds of sound inventions. Can you help supply their wants? The book is free. Write for it today. H. S. Hill, 929 McLachlen Bldg., Washington, D. C.

PATENTS, Trade Marks, Copyrights. Prompt, personal, reliable service. Over 30 years' active practice. Difficult and Rejected Cases Solicited. Write for terms. Book free. Address E. G. Siggers, Box 1, N. U. Building, Washington, D. C.

PATENTS: Our practice before the Patent Office extends over seventy years. It pays to employ an attorney of reputation as a poor patent is a bad investment. Ability and Reliability are our special partners. We are also the publishers of the Scientific American and all patents secured by us are described without cost in the Scientific American. Your invention is thus brought to the attention of thousands of intelligent readers especially interested in such matters. To procure like publicity in any other manner would cost you many times the patent fees. Our hand Book on Patents sent free on application. Munn & Co., Patent Attorneys, 624 Woolworth Building, New York, and 625 F St., Washington, D. C.

BEFORE spending money patenting your invention try selling it. For particulars and suggestions address International Development Company, Dept. G, 922 F St., Washington, D. C.

PATENTS—Send sketch for free search and report. Books on patents, book of reference letters, and dining table novelty sent free. John S. Duffie & Co., 608 F Street, Washington, D. C.

PATENTS obtained through D. Swift are being sold to Large Manufacturers. Write today for free books of "Inventions needed" and surpassing references. D. Swift, 371 Seventh St., Washington, D. C. Established in 1889.

PATENTS Bring Riches. Protect Your Invention. Attorney's fees payable when patent allowed. Plain advice and "Patent Facts" free. Trade-marks registered. Jaynes and Jaynes, 600 Kellogg, Washington, D. C.

YOUR idea wanted. Patent your invention. I'll help you market it. Send for 4 free books, list of patent buyers, hundreds of ideas wanted, etc. Advice free. Patents advertised free. Richard B. Owen, Patent Lawyer, 44 Owen Bldg., Washington, D. C., or 2276Z Woolworth Bldg., New York.

PATENTS—Herbert Jenner, patent attorney and mechanical expert, 622 F St., Washington, D. C. I report free of charge if a patent can be had and its exact cost. Send for circular.

PATENTS Wanted—Write for List of Patent Buyers who wish to purchase patents and What to Invent with list of inventions wanted. Send sketch for free opinion of patentability. Our Four Guide Books sent free upon request. Patents advertised free. We assist inventors to sell their inventions. Victor J. Evans & Co., 155 Ninth, Washington, D. C.

PATENTS that protect and pay. Advice and books free. Highest references. Best results. Watson E. Coleman, Washington, D. C.

INVENTIONS of merit can be sold by our system. For further particulars write American Investment Co., Washington, D. C.

AMERICAN Patents and Trade-Marks. F. V. Winters, Patent Lawyer, 125 East 23rd Street, New York City. Secures patent protection everywhere. Telephone Connection.

FITZGERALD & CO., Patent Lawyers, 801 F St., Washington, D. C. Est. 1880. "The Old Reliable Firm." Free handbook.

DON'T lose your rights to patent protection. Before proceeding further send for our blank form "Evidence of Conception" to be signed and witnessed. Book, suggestions and advice free. Lancaster & Allwine, 232 Ouray Building, Washington, D. C.

THE Patentome is free. An education in obtaining patents. Established 1865. Anderson & Son, Attorneys, 712 7th St., Washington, D. C.

"QUICK-ACTION Advertising—How it is Building Business for the Progressive Advertisers of America." A little story of Results, told by the advertisers themselves—not the publisher. You will be interested in reading the little booklet we have prepared, a copy of which will be gladly sent upon request. It may solve YOUR problem. D. W. Coutlee, Classified Department, Popular Science Monthly, 225 West Thirty-ninth Street, New York.

INVENT Something. Your ideas may bring wealth. Send postal for free book. Tells what to invent and how to obtain a patent through our credit system. Talbert & Talbert, 4624 Talbert Bldg., Washington, D. C.

TO Market Your Invention, you must get in touch with the proper persons. Let me show you how to do it. D. W. Coutlee, 225 West 39th Street, New York City.

INVENTORS: We undertake sale of patents we obtain. Write Fisher Mfg Co., 2183C, Railway Exchange, St. Louis, Mo. Agents.

PATENTS! Foremost word free. Metzger, Washington, D. C.

PATENTS, make your ideas pay. Hundreds inventions are sold yearly. We help market yours free. Book and advice free. A. M. Buck & Co., 534 7th St., Washington, D. C.

PATENTS on easy payments. Send model or sketch for free search and Certified registration of your invention for your protection. Free book tells what to invent and how to obtain a patent on easy payments. C. C. Hines & Co., 592a Loan and Trust Bldg., Washington, D. C.

Prominent New York business men desirous financing meritorious inventions protected by me. Send your ideas. Honest advice and "Truth about Patents" free. J. Reaney Kelly, 742 Woodward Bldg., Washington, D. C.

PATENT applications filed on partial payment plan. We help sell the patent. Trade-marks, copyrights, etc. Milo B. Stevens & Co., 640F St., Washington. 351 Monadnock Blk., Chicago. Estab. 1864.

PATENTS that Protect. Write us for new book, "Patent-Sense," worth more than all other patent books combined. Free. Write Lacey & Lacey, 127 Springer Building, Washington, D. C. Established 1869.

"QUICK-ACTION Advertising—How it is Building Business for the Progressive Advertisers of America." A little story of Results, told by the advertisers themselves—not the publisher. You will be interested in reading the little booklet we have prepared, a copy of which will be gladly sent upon request. It may solve YOUR problem. D. W. Coutlee, Classified Department, Popular Science Monthly, 225 West Thirty-ninth Street, New York.

Digitized by Google

REAL ESTATE—FARM LANDS

$10 DOWN, $5 a Month for a fine little rm of your own. 10 acres, $300. Poultry, uit, truck make good money. Michigan's st County. Near towns, schools, churches. so larger tracts. Full information free. igart, O1251 38 S. Dearborn, Chicago.

CALIFORNIA little farms near Los ngeles for sale. Easy terms. Write E. R. aite, Shawnee, Oklahoma.

OWN your own Orange or Grapefruit ove in beautiful Fruitland Park. Let me l you how melons, peaches, hay, your st crops, should pay for your land and ove. J. Q. Lloyd, Desk 205, Fruitland rk, Florida.

I Want to send you proof of the wonderful lling power of the Classified Columns of s magazine. If you want to buy some- ng, sell something or exchange something, ite today for full particulars. D. W. utlee, Manager Classified Department, pular Science Monthly, 225 West 39th reet, New York.

IS He Crazy? The owner of a plantation Mississippi is giving away a few five- e tracts. The only condition is that be planted. The owner wants enough raised to supply a Canning Factory. u can secure five acres and an interest the Factory by writing Eubank Farms mpany, 934 Keystone, Pittsburg, Pa. ey will plant and care for your trees for per month. Your profit should be $1,000 year. Some thing this man is crazy giving away such valuable land, but re may be method in his madness.

MONEY-MAKING Farms—15 States— an acre up. Stock, tools and crops often luded to settle quickly. Write for Big strated Catalogue. Strout Farm Agency, pt. 12, New York.

FOR MEN AND WOMEN

YOU can turn your spare time into dollars taking subscriptions from your friends and quaintances. You, as a regular reader of pular Science Monthly, know its good nts and can present its attractive features a way which will readily secure a large mber of subscribers. Convince me that are in earnest and willing to take ad- ntage of this opportunity, and I will gladly d you full particulars as to how to go ut the work, and also special appointment bers for your territory. Don't wait until r neighbor has secured the appointment— te today. Circulation Director, Popular ence Monthly, 225 West 39th Street, w York.

NDIAN Baskets—Wholesale and retail. alogue. Gilham, Highland Springs, ifornia.

SEXUAL Philosophy," 12. Clear, cific, authoritative, complete, best satis- Fred B. Kaessmann, Lawrence, Mass.

WE WRITE Business-Building Letters, vertisements, Circulars and Booklets, attractive rates. Results guaranteed. at is Your Problem? Criterion Service, p't. 1, West New York, New Jersey.

BE a Detective. Excellent opportunity, d pay, travel. Write C. T. Ludwig, 424 stover Bldg., Kansas City, Mo.

WHAT Do You Want to Know?—In- nation vital to the student, the experi- nter, the business man, or any inquirer en by experts. Educational, Scientific, al, and Business questions answered. us the points you cannot find out any- re else—we usually know. No charge if uccessful, small fee of $1 if we set you t. Send your questions direct from this or write for our complete proposition. The Kent System, Department [illegible] nbridge, Mass.

BEAUTIFUL Rubber B[illegible] r. Postpaid 50 cents [illegible] rks, Ashland, O.

ZODIAC Horoscope [illegible] racter, talents [illegible] your life [illegible]

[illegible]

FOR INVENTORS

FIND Out for Yourself what to invent and how to procure and sell a patent for the same. My book, "Inventor's Universal Educator," covers the matter from A to Z. 140 pages, elegantly bound. Also contains 600 mechanical movements and 50 perpetual motions. Price $1.00, postage free. F. G. Dieterich, 601 Ouray Bldg., Washington, D. C.

PATENTS without advance attorney's fees. Free report and books. Frank Fuller, Washington, D. C.

HAVE you an idea? If so, you should protect it by a patent. Send us a model or sketch for free opinion of patentability. Write for our Four Books sent free to any address. Victor J. Evans & Co., 156 Ninth, Washington, D. C.

INVENTORS—We specialize in manufacturing new patented articles, make models—dies—and do experimental work. Leo J. Gerding Mfg. Co., Dept. E., Opera Place, Cincinnati, Ohio.

PATENTS Wanted. Inventors write for Free Booklet. Tells how to get the cash value of your invention. Fredk. E. Wooten, Sta. F., Philadelphia, Pa.

INVENT Something. Your ideas may bring wealth. Send postal for Free book. Tells what to invent and how to obtain a patent through our credit system. Talbert & Talbert, 4691 Talbert Building, Washington, D. C.

PATENTS on easy payments. Send model or sketch for free search and certified registration of your invention for your protection. Free book tells what to invent and how to obtain a patent on easy payments. C. C. Hines & Co., 592a Loan and Trust Bldg., Washington, D. C.

PATENTS that protect and Pay. Advice and books free. Highest references. Best results. Watson E. Coleman, Washington, D. C.

WE will commercialize and manufacture that electrical or mechanical invention for you. Confidential development and experimental work. Tools, dies, and models. Precision Engineering Co., 2914 Woodburn Ave., Cincinnati, Ohio.

HAVE You a Patent to Sell? My method will enable you to get in touch with the proper persons. Write today for details. D. W. Coutlee, 225 West 39th Street, New York City.

BEFORE spending money patenting your invention try selling it. For particulars and suggestions address International Development Company, Dept. F, 922 F St., Washington, D. C.

INVENTORS—Can place patents very quickly. Benjamin Jonap, Marion Building, Cleveland, Ohio.

WRITE us if you want to sell or patent your invention. Free confidential advice. Smith's Patent Office, Publicity Building, Boston, Mass.

DRAWINGS, Models. Specialists on gas engines and aeroplane work. Arthur Haar Company, 1269 Broadway, New York.

INVENTORS: Cash or royalty paid for your invention or patent. Square deal assured. References furnished. Established 1898. We secure patents, form companies, make models and manufacture for the markets. Send sketch, model or patent [illegible] to Fisher Mfg. Co., 2183A [illegible] change, St. Louis, Mo.

INVENTORS—[illegible]

AGENTS $40 a week. New, patented, automatic wardrobe. No nails, no screws. No competition. Demonstrate and sale is made. Dozen can be carried. Write for sample. Thomas Mfg. Co., 2561 North St., Dayton, Ohio.

"QUICK-ACTION Advertising—How it is Building Business for the Progressive Advertisers of America." A little story of Results, told by the advertisers themselves—not the publisher. You will be interested in reading the little booklet we have prepared, a co y of which will be gladly sent upon re-qu st. It may solve YOUR problem. D. W. Coutlee, Classified Department, Popular Science Monthly, 225 West Thirty-ninth Street, New York.

WANTED—New Ideas. Write for list of Patent Buyers and Inventions Wanted. $1,000,000 in prizes offered for inventions. Our Four Books sent free upon request. Victor J. Evans & Co., 174 Ninth, Washington, D. C.

SWELL suit free for 2 hours' work. Show it to your friends and make $5.00 an hour in your spare time. We show how. Costs nothing to try. Write quick for measure blank and our handy sample outfit. All free. We deliver everything free. Look into this Paragon Tailoring Co., Dept. 6A51, Chicago.

INSYDE Tyres, inner armour for Automobile Tires, prevent punctures and double mileage of any tire. Liberal profits. Details free. American Accessories Co., Dept. 97, Cincinnati, Ohio.

MANUFACTURERS of a Famous Polishing Cloth want house-to-house canvassers. Excellent proposition. Famous Products Company, Decatur, Illinois.

WERE You Ever Offered a Grocery Store? Our Proposition Is Better. Let us tell you how you can handle Flour, Canned Goods, Provisions, and entire line of groceries, as well as Paints, Roofing, Stock Foods, Automobile and Machinery, Oils and Greases. No rent to pay. No investment in stock. Large orders taken from samples. Goods of guaranteed and proven quality. Selling experience not necessary. Very profitable work for "workers." Address, Hitchcock Hill Co., Dept. 220, Chicago, Ill. Reference: Any bank or express company.

HUNDREDS of Agents are now making goods to sell from Miller's Guaranteed Manufacturers' Formulas. Wizard Washing Tablets—no wax, potash, lye. Costs 5c pound. Brings 60c. Eggolene, only pure food substitute for eggs at 9c a dozen. Non-Alcoholic Tube Flavors. Many new sellers including latest Automobile Specialties. Carbo-Cide, the only recognized gasoline Intensifier-Decarbonizer—800% profit. Enormous sales. Fibro-Vac Guaranteed Puncture Plugger. Exclusive territory. Particulars or stamp. Miller, Industrial Chemist, Tampa, Florida.

"RADIO" Luminous Paint for resale. Big demand—big profits. Trial can, 50c delivered. American Luminous Products Co., Huntington Park, California.

AGENTS, "Eggite," the guaranteed substitute for fresh eggs, means eggs at 8 cents per doz.; enormous demand everywhere; big profits; sample free. Thomas A. Dougherty, 157 East 47th St., New York.

HOSIERY and Underwear Manufacturer offers permanent position supplying regular customers at mill prices. $50.00 to $100.00 monthly. All or spare time. Credit. J. Parker Mills, 2733 No. 12th St., Philadelphia.

NINETY Per Cent. of Your Calls Turned into Sales! Wonderful Enthusiasm Follows Every Demonstration! Write at Once for Full Particulars of Our Line of Eradium (Luminous) Articles. Startling! Mysterious! Everlasting! Novel! They Shine in the dark. Crucifixes, House Numbers, Bulbs, Match Boxes, Pictures, Switch Plates. Sole Manufacturers. The Pioneer Corporation, 1263 W. 63rd, Chicago.

AGENTS—Steady income. Large manufacturer of Handkerchiefs and Dress Goods, etc., wishes representative in each locality. Factory to consumer. Big profits, honest goods. Whole or spare time. Credit given. Send for particulars. Freeport Mfg. Co., 24 Main St., Brooklyn, N. Y.

AGENTS: Sell rich looking 36 x 68 imported rugs, $1.00 each. Carter, Tenn., sold 115 in 4 days; profit $57. You can do same. Write for sample offer selling plan; exclusive territory. Sample rug by parcel post prepaid, 98c. E. Condon, Importer, 12 Pearl Street, Boston, Mass.

I WILL pay any honest man up to $50 monthly for part of spare time. No canvassing. No capital. Write today. Voorhies, Dept. P. S., Omaha, Nebraska.

FASTEST Dollar Seller on the automobile market. 100% to agents. Permanent repair for inner tubes. Every motorist will buy. Consumers Mfg. & Supply Co., Minneapolis Minn.

233 per cent profit selling Jubilee Spark Intensifiers to auto owners, garages; banishes spark plug trouble; sells like wildfire; exclusive territory; write quick. Jubilee Mfg. Co., Dept. P-6, Omaha, Nebraska.

QUICK, snap this winner; brand new, big profits; sells on sight; unlimited field; particulars free. Dept. 19, Sunnyside Co., 614 Sunnyside St., Danville, Va.

MAKE and Sell Your Own Goods. Machinery unnecessary. Expert Chemists advise. Special attention to beginners. Write for Formula Catalog. Elmer Mystic Company, Washington, D. C.

"AGENTS:—Specialty Men sell the Simplex Auto Brush, new auto and wagon washer fits any hose; sure, quick cash sales; free samples. Franck M. Mfg. Co., Harrisburg, Pennsylvania."

AGENTS. Big money selling Wardrobe Odorizers, sample 35c., particulars free. Webster & Co., 2936 N. Clark St., Chicago, Illinois.

AGENTS: Our new inventions will earn you steady income. Canvassers, County Rights Salesmen and Promoters write Fisher Mfg. Co., 2183G, Railway Exchange, St. Louis, Mo.

BUILD Permanent, Profitable medicine and toilet preparation business. Agents selling Alfalfa's Products eight years. Fully Guaranteed, 56-page book, particulars Free! Alfalfa, 850 Northwestern Building, Chicago.

AGENTS: Big profits. Best and cheapest window letters made. Easily applied. Dime brings five samples. Auto Monogram letters. Particulars free. Stalbrite Company, 1115 Second Avenue, New York.

"GASOLINE Saver For Fords: New principle; saves 30% gasoline; gives 30% more power. No moving parts; put on with wrench in 10 minutes. Price $1.50. Guaranteed. 100% proposition to agents. The Little Cyclone Accessories Co., Dayton, Ohio.

SELL beautiful fragrant California Rosebeads. Absolutely new. Big profits. Catalog free. Mission U2819, West Pico, Los Angeles, California.

PRESTO, Slip up Your Sleeves over Elbows, without unbuttoning. Cuffs open and close automatically when raised or lowered. Great convenience. Abnormal profits. Sells everywhere. No competition for competent salesmen who sell direct to wearer. Enclose stamp. Flexo, P. S., Sheboygan, Wisconsin.

STOP Here—Sell the Elsen Regulator for Ford Headlights. Going like wildfire everywhere. Gives splendid driving light at low speed—keeps bulbs from burning out—operates automatically. Wanted for every Ford. Big profits quick. LISTEN: Siler, Okla., sells 12 daily, profit $20. McFarland, Nebr., made $3,420 in 17 weeks. No experience necessary—we show you how. Not sold in stores. Sales guaranteed. No capital necessary. Write today for special offer. Address Elsen Instrument Co., 695 Valentine Bldg., Toledo, Ohio.

IF You want live, active and intelligent agents and salesmen to handle your goods, let me show you how to reach them. D. W. Coutlee, 225 West 39th Street, New York City.

GET Davis' 1918 Prosperity Offer—Best in 21 Years—Our Food, Soap and Toilet Goods cut store prices ⅓ to ½. Everybody buys to lower living cost. E. M. Davis, Dept. 51, 910 Lake St., Chicago.

"QUICK-ACTION Advertising—How it is Building Business for the Progressive Advertisers of America." A little story of Results, told by the advertisers themselves—not the publisher. You will be interested in reading the little booklet we have prepared, copy of which will be gladly sent upon request. It may solve YOUR problem. D. W. Coutlee, Classified Department, Popular Science Monthly, 225 West Thirty-ninth Street, New York.

BUILD a business of your own. Enjoy independence. Sell our $5,000 Health and Accident Policy with $25 weekly benefit for $10 yearly. You get all products on yearly renewals. Write today. North American Accident Insurance Co., 904 Bonnell Bldg., Newark, N. J.

image
not
available

Answer This Call!
rn Draftsmanship

:eds skilled draftsmen. epartment of the Gov- nothercall; this time for 1800 ; big salaries. The manufac- e clamoring for more skilled nches. Salaries paid compe- hough high at the present go still higher. The serious n is recognized in both gov- 'acturing circles, for drafts- y foundation of all Engineer- l Manufacturing enterprises.

rtunity. Help your country n Draftsmanship. There will t a good salary the very day Draftsmen in ordinary times .00 a week. What will this he scarcity of competent men of salaries? And remember great business organizations pay the full worth of the trained men.

Quickly By 'Tech" Methods

given by the Chicago Technical Col- s. Your instructors will be practical ngineering work. They teach by ap- go "Tech" methods—demonstrated to No time is put in on needless theories. xperience on your part is not neces- bedrock principles and their practical nonths you will gain what would take drawn out methods—and at the end lraftsman—with all that term means ncome.

ly at Home

our present occupation to get this ex- manship. We will teach you by mail ome in your spare time. Same prac- l have if you were a student in either our Day or Evening Classes at the College here in Chic

Pay for the course as you go along. The fee is so small, terms so easy that no matter how moderate your income be, you can afford to get this training in Draftsmanship w will prepare you for an important paying position.

Drawing Outfit

A complete high grade drawing outfit is included with course without extra expense to you. This includes all ne sary tools just as used in the best modern drafting rooms you already possess such an outfit you will be allowed a credit for it.

Send For Test Lesson

This Free Test Lesson is an absolute test, pure and simple. Find out for yourself before you enroll, whether you are proper material for a successful draftsman. No charge for this Test Lesson either now or later. It is absolutely Free. Send for it today. Mail the coupon, marking it to indicate which branch of drafting especially interests you.

Chicago Technical College
631 Chicago "Tech" Building **Chicag**

Chicago Technical College
631 Chicago "Tech" Building, Chicag

Without obligation to me, please send me your FREE Lesson in Draftsmanship and other interesting literatur c ing the subject indicated below.

(Mark X opposite work in which you are specially interes

☐ Architectural Drafting	☐ Builders' Course
☐ Machine Drafting	☐ Plan Reading
☐ Electrical Drafting	☐ Estimating
☐ Structural Drafting	☐ Surveying
☐ Sheet Metal Drafting	☐ Map Drafting

Name ....

Address ....

City .... State ....

College or Home Study? State which ....

image
not
available

Come to Detroit
The Automobile Center and

ARN THE AUTOMOBILE BUS

quic
give wha
what it means t
Factories endorse ou
our graduates. 71% of
Detroit. Men are needed ev
pair men, chauffeurs, garage men ar
of our graduates start in business for the

Earn $75 to $300 a

g for
d

We teach you to handle any auto proposition. You
12 weeks. Equipment is new, up-to-the-minute, comp
motors, or chasses used. Students actually build cars, get
assembling, block-testing, road-testing, everything. Special c
Acetylene brazing, welding and cutting, also Tire Repairing separa
Learn to time motors, rebore cylinders, adjust bearings and carburetors
Six-cylinder Lozier, Chalmers "6", Detroiter "6", Overland and 8-cylinde
instruction. We have 25 motors in block test department. Our electrical c
having every standard starting, lighting and ignition system.

Detroit is the Place to Learn—Start A

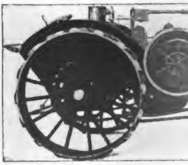
44 Auto factories in Detroit and vicinity and 144 accessories and parts factories.
perience in handling all kinds of auto equipment. We have Sprague Electric Dynamo
rposes for students' use. Ours is the only Auto School having this equipment. School open
time, any day. Three classes daily; morning, afternoon, evening.

nplete Tractor Instructions Added to Au

onal Harvester Company of America
(Incorporated)
ters and Other Lines of Machinery
Harvester Building
CHICAGO, November 20, 1917.

LLER, President,
State Auto School, Detroit, Michigan.
LLER:
careful examination of your school, we are
it will be a very wise thing for us to co-
you. We are therefore placing in your
struction purposes, one of our Titan 10-20
ther with an engine completely equipped
and a complete transmission.
y to co-operate with you in the excellent
doing by giving your school all the data and
t only on tractors, but on conditions gen-
be used in developing thoroughly practi-
actor operators and mechanics.
e of co-operating with the factories is very
for it brings together the biggest men and
l ideas to be had. As you know, there is
and for tractor men who are trained and
as taken thousands of men from the farms
will have to be replaced, and thousands
eded to care for the big crop increases.
y co-operate with the Michigan State Auto
our ninety branches in the United States
tractor graduates. There is a constant
npetent trained tractor men at very good
Very truly yours,
ONAL HARVESTER COMPANY OF AMERICA
Heiskell, Advertising Manager.

Our Automobile Course has always included all the instructions necessary to handle Tractors. By adding I. H. C. Titan 10-20 complete tractor for actual working conditions and a complete engine and transmission for the block test department we are training our students in the care, repair and operation of the Tractor. The Oliver Chilled Plow Works of South Bend, Ind., placed their No. 78 automatic lift three bottom tractor plow in our school for student work. When students leave our school they are trained in every branch of work and can repair, maintain and operate Automobiles, Trucks and Tractors. Get your training in the original school.



ories Endorse chool

Auto Factories en-
ol. They put their
omplete chasses in
ploy our graduates
hem in opening
lesrooms.

Take Course

have taken our
are holding good
e completely satis-
structions and the
atment accorded

antee

qualify
as chauf-
, tester,
o electri-
automo-
lane mo-
ctor me-
r. paying
monthly
ey.

GET INTO THIS NEW INDUSTRY NOW

We have a Curtiss Aeronautical Motor for practice and study. We have a complete plane and a quantity of aeroplane material. Students get practical instruction on the Aeroplane Motor and secure complete knowledge of the plane in general. The course is under direct supervision of an experienced aeroplane man who is an authority on aero-motors and aeroplanes. The men who become trained Aeroplane Mechanics now will be the big men in the aeroplane business. The far sighted keen fellows who enter at once will reap the big benefits.

Act Quickly—NOW! Get literature on Aeroplane Motor Mechanics, Auto and Tractor Course. Tire Repairing, Brazing and Welding, "Auto School News" and New 176-Page Illustrated Catalog. All absolutely free. Or better still, jump on the train, as hundreds have done, and come to the "Heart of the Automobile Industry," and learn right. We have no branches. Write or come direct to this school

A REFUND WILL BE GIVEN TO STUDENTS CALLED TO THE ARMY

MICHIGAN STATE AUTO SCHOOL

The Old Reliable School — A. G. Zeller, President
586 Auto Building, 687-89-91 Woodward Ave., Detroit, Mich., U. S. A.

image
not
available

. Frank W. Potts, formerly with the Ford Automobile Company, wrote us the other day as follows:

IR. JOHN A. TENNEY, President, National Aero Institute, Chicago, Ill. Detroit, Mich.

Dear Mr. Tenney: Today I have entered the employ of the Packard Motor Car Company to work in the Experimental ircraft Department. I had my first big opportunity to see and look over the wonderful Liberty Motor. I am only too lad to say that I owe this wonderful opportunity to the National Aero Institute and to my study of your great Course. was through your influence with the Packard people and the fact that I was thoroughly interested in aeronautics that was able to get this position. I feel that I am on the road to a genuine success, and I owe it all to the National Aero stitute. Am sending under separate cover the enrollment of a new student. Sincerely yours, FRANK W. POTTS.

en Wanted!

J. S. Government plans to send ds of men to Europe who will be compe- keep its great airplane fleet in good order—a great mechanical army which will be as in its way as any other branch of the service.

ch You Aviation by Mail at Home

spare time. Your training will be under on of experts—men who have great reputa- e field of aeronautics.

Send Coupon for FREE BOOK

Just write your name and address in the coupon and send it to us. We wilt send you our free book, "THE SCIENCE OF AVIATION," and our Special Limited Offer on our complete Mail Course. This book will tell you of the many big opportunities you will have in this great new industry. Tear out the coupon and mail it today. DO IT NOW!

NATIONAL AERO INSTITUTE
Dept. 1206, Morton Building, Chicago, Illinois

National Aero Institute, Dept. 1206, Morton Bldg., Chicago,
Gentlemen: Please send me, absolutely free and prep your new book on the Science of Aviation; also particu of your Mail Course in the Principles of Aviation and cial limited offer.

Name..

Address..

1918 Edition

; Automobile Handbook

cal instruction book covering every feature of all motor cars. Revised by H. P. Manly. 720 pages, fully illustrated. Bound in limp leatherette, gold stamping. Pocket size. Sent prepaid for.......**$2.00**

Send for our large catalogue showing over 150 books for Electricians, Wireless Operators, Automobilists, Engineers, Railroad Men, Machine Shop Men, Carpenters, Builders, e Painters, etc. It is FREE.

)RAKE & CO., 1003 Michigan Ave., Chicago

Check the Job You Want

Thousands War Jobs Open

....Railway Mail Clerk $900 to $1800	....Customs Positions $ 800 to $1
....Postoffice Clerk $800 to $1200	....Internal Revenue $ 800 to $1
....Postoffice Carrier $800 to $1200	....Stenographer $1200 to $1
....Rural Mail Carrier $600 to $1200	....Clerk at Washington $1100 to $1

Name..

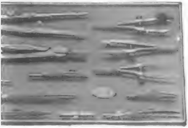
Address..

Sign your name and address and send us this coup immediately. We will immediately send you (1 full description of the position checked, (2) a list many U. S. Gov't Jobs now open and directions telling to get free coaching for the position checked.

Franklin Institute, Dept. P111, Rochester, N.

EE Complete $15.00 Set o Drawing Instrument

ou this exquisite set of imported drawing instruments absolutely free and I will give you a 20 x 25 inch dra T square, a 12-inch rule, a supply of drawing paper, 2 triangles and a French curve, pencils, erasers, thumb ta etc. The instruments come in a superb plush lined leather case—they are g working instruments and I don't think you could duplicate this outfit for less $15. But I give it away *absolutely free* to the men who get my personal instru



Draw $125 to $175 Per Month There is urgent demand for skilled d men. Companies are issuing calls ever for men to fill positions paying from $125.00 to $175.00 per month. I will give you ju training you need to hold one of these big jobs—right in your own home Write

Send Coupon for Big New Book

Write me personally for my new book on drafting—sent free Send the coupon now.

Chief Draftsman Dobe
Engineers Equipment Co., Inc.
Div. A-120
Chicago, Ill.

Chief Draughtsman Dobe
Engineer's Equipment Co.
Div. A-120. Chicago, Il

Without any obligations on me whatso please mail your book "Successful D manship" and full particulars of your "Personal Instruction" offer to a few stud It is understood that I am obligated in n whatever

Name ....

Address ....

Digitized by Google

image
not
available

I Earned $2200.00 IN FOUR MONTHS

This is Richard A. Oldham

Mr. Oldham was telegraph operator for the Illinois Central Railroad for twenty years. He is fifty-eight
rs old. One day he read one of my advertisements and the possibilities of making
y in the Auto Tire Repair Business. In a few weeks, he had purchased and installed
ood outfit, and was doing business for himself. A short time ago he wrote us that
e in four months was as much as it had been in Two and One-Half years as Telegraph

There are **thirty million** tires in use every day—punctures and blow outs are com-
thing going wrong all the time. New tires advancing to prohibitive prices.
l to have their old tires fixed. I have 500 other places to be filled now.

I Must Have 500 Men

'o fill these places within the next 60 days

; book to send you—a book about tires—it tells all about them—how they
ywood method—explains this business—gives inside figures, and profit
ccess. What these men have done you can do. $2500 to $4000 a year
machine will give you a start. All you do is open a shop—put out a
owners will come to you. There is a big opportunity awaiting you.

upon and mail it today, or send a post card or letter.

/OOD TIRE & EQUIPMENT CO. 794 Capitol Avenue, INDIANAPOLIS, IND.

M. HAYWOOD, Pres.
Haywood Tire & Equipment
794 Capitol Avenue,
Indianapolis, Ind.

DEAR SIR:—Please send me y
book on Haywood Tire Repair Pla
and full particulars on your Natio
Tire Repair Service and details of y
FREE school of tire repairing.

NAME ....

ADDRESS ....

Know

iish war bonds
sold at 112½%

e companies have over
invested in farm mortgages?

t Through Partial Payments?

nt kinds of bonds?

you are an experienced in-
find it worth while to read
lets in

e Scribner
nvestment Series

want from the titles follow-
t cost: "How to Invest"—
he Investor"—"Our Foreign
'—"Partial Payment Invest-
ment Position of Municipal
Farmer Must Be Financed"
Mortgage as an Investment."

or's Service Bureau

ER'S MAGAZINE
venue New York

BE AN ARTIST

CHECK FROM MAGAZINE

DRAWN BY 14-YEAR-OLD BOY

The above cartoon was drawn by Master Bob Brennan of the Washington School of Art. Bob writes that he is selling his work and that he is cartoonist on a small paper in Evansville, Ind. He is but one of our many students and graduates who are making money as cartoonists, illustrators and designers.

Learn By Mail at Home!

By our new method of teaching drawing by mail you can learn in your own home, in a short time. Get into this fascinating work yourself and earn $50 to $100 or more per week:
The study is fascinating. Only a few minutes a day! Have your own studio or secure high-salaried position. Or work in spare time. Many students earn while they are learning.

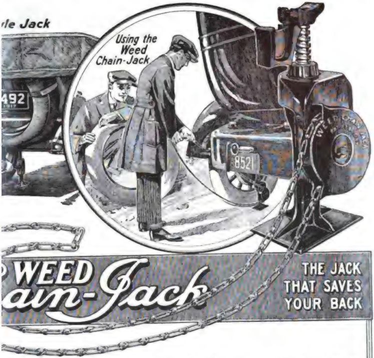
FREE! BOOK AND ARTISTS' OUTFIT! WRITE TODAY

A complete Outfit *free* to all students. Includes everything required to produce hundreds of dollars' worth of pictures. Write today. Special terms to a limited number of new students. Mail postal or letter for beautiful Booklet, "How to Become an Artist," filled with drawings and full particulars of our extraordinary offer. Do it now—before you forget.

WASHINGTON SCHOOL OF ART, Inc.
1116 H Street, N. W., Washington, D. C.

Digitized by Google

image
not
available



few pulls on its chain and the heaviest car is raised owered without danger and without exertion.

; dreaded using the ordinary jack—an unpleasant operation, to say the least, and constantly fraught with resome work. Now all the unpleasant, disagreeable features have been ***entirely eliminated*** by the Weed it, whether raising or lowering the car, you are always ***out of harm's way***—No knocking of head, or gainst springs or other projections—***No skinning of knuckles*** or flying up of a "handle"—***No chance g down,*** often resulting in serious bodily injury—Infinitely easier to operate than any jack on the market.

ed Chain-Jack it is not necessary to get l, strained position and grovel in the mud, der a car to work a "handle" that is apt pleasant results. ***To lift a car*** with the , simply give a few pulls on its endless stand erect—clear from springs, tire car- ojections. ***To lower a car*** pull the chain m. Up or down—there's no labor

Once in place you never have to touch a Weed Chain-Jack. You do not have to crawl underneath to either raise or lower the car and after the car is lowered, you haul the jack out from under the car by the chain. ***Much superior*** in safety, economy, utility, simplicity and construction.

You will never be satisfied with any other if once you use a

Weed Chain-Jack

Powerful—Safe—Easily Operated

, providing the kind of support from which an axle will not slip, while a **broad base** rom upsetting on uneven roads. **Every Weed Chain-Jack is** submitted to a lifting rt over twice the weight it is ever required to lift. **Never gets out of order.** Gears rotected by a stamped-steel housing. **Chain heavily plated** to prevent rusting.

ADE IN FOUR SIZES

Whe ed	Height When Raised	Height When Raised When Aux. Step Up	Price
ies	12 1-2 inches	14 1-2 inches	$7.50
hes	15 3-8 inches	17 3-8 inches	7.50
hes	18 1-2 inches	No Aux Step	7.50
hes	19 1-4 inches	No Aux Step	15.00

The 8 inch and 10 inch sizes are made with an auxiliary step as illustrated above. When in operative position this step adds two inches to the height of the jack.

10 Days' Trial

If your dealer does not have them size for pleasure cars or $15.00 for the Truck size, and we will send you one, all For delivery in Canada send $8.50 for any size for pleasure cars or $16.00 for ry it 10 days. If not satisfied, return it to us and we will refund your coupon.

n Chain Company, Incorporated
Bridgeport, Connecticut
minion Chain Company, Limited, Niagara Falls, Ontario
Largest Chain Manufacturers in the World
—all types, all sizes, all finishes—from plumbers' safety chain to ships' anchor chain

TRIAL COUPON

American
Chain Co. Inc.
Dept. 2
Bridgeport, Connecticut

Gentlemen: Enclosed find $ 7.50 / 15.00. Send me a Weed Chain-Jack. (Size in.) It is understood I am to try it for 10 days, and if not satisfied I am to return it and you will refund the purchase price.

Name . . . .

Address . . . .

image
not
available

Multiplies Man's Power

Efficiency tools—you've alway wanted them. Nov extraordinary industrial condi tions **demand** them. "YANKEE Tools save a fourth to a half of a man's time; require les skill; less labor; enable better work. For example:

"YANKEE" Bench Dril

does away with hand feeding. It has the exclu sive "YANKEE" Friction and Ratchet Feed Automatic! A quarter turn of the tiny leve (see illustration) and the rapid Friction Feed runs drill to contact; the Ratchet Feed automatically takes up the work, maintaining a po tive, even pressure all the way through—saving drills and leaving on hand free to hold the work. Reverse the little lever, and drill is easil and quickly withdrawn. Gears can't jam or strip, because Feed i automatically thrown off at either extreme.

Speed and efficiency! No time lost; no adjustment; no guesswork nothing to go wrong. Multiplied man power!

Especially in demand for shops and garages not equipped with powe

"YANKEE" Bench Drill No. 1005. Two speeds. 3-jaw chuck, holds drills u to ½ inch. Height, 28 inches. Price (Philadelphia) **$16.5**

"YANKEE" Bench Drill No. 1003. One speed. 3-jaw chuck, holds drills up to ! inch. Height, 18¾ inches. Price (Philadelphia) **$10.0**

"YANKEE" Vise No. 990. Accurately machined sides, ends and bottom, for hol ing work on bench drills. Swivel jaw for taper work; groove for rounds. Base, 6 in. long, 2⅜ in. wide. Price . . . **$2.20**

Your dealer can supply you

Write us for "'YANKEE' Tool Book"—free. Tells how to save time and labor in working in wood and metal.

NORTH BROS. MFG. CO., Philadelphia

YANKEE" TOOLS

Make Better Mechanics

image
not
available

Gillette
Safety Razor

Have You Seen the New Gillettes Specially Designed for the Fighting Man?

THESE models were designed by members of the Gillette Organization who have seen service with the Colors and know what the soldier is up against.

Hundreds of officers and men are buying them—the U. S. Service Set in metal case, and the new Khaki-covered sets for Uncle Sam's soldiers and officers.

The Gillette is the one razor for the man who is doing things—the one razor with world-wide use and reputation.

When a man wants new Blades he can get them at any Post Exchange or Y. M. C. A. Hut—here in America or Overseas.

Our Paris Office carries stocks—is constantly supplying the American Expeditionary Forces. Gillette Safety Razors and Blades on sale everywhere in France, England, Italy and the Eastern battle fronts.

· *the Gillette*
pecially the Soldier's Razor

isn't a harder shav- earth than the ser- ıded of the Gillette ıting man.

he very worst pos- tions of climate — ır hard water—on l or wind-chapped Gillette is called its solid-comfort, ›oth shave. **And**

There are more Gillettes used than all other kinds of razors added to-gether—the compact, complete razor with no strops or hones to clutter up the kit.

Hundreds of thousands of officers and men have adopted the Gillette—with its blades always sharp, always ready. No Stropping, No Honing.

LETTE SAFETY RAZOR COMPANY

BOSTON, MASS., U. S. A.

r Company, of Canada, Ltd.
ınder St., Montreal

Gillette Safety Razor, Limited
200 Great Portland St., London, W., England

ɫazor Societe Anonyme
Boetie, Paris, France

A. G. Micheles
53 Liteiny, Petrograd, Russia

Vedova Tosi Quirino & Figli, Via Senato, 18, Milan, Italy

image
not
available

in your town, a branch of the
'inchester Junior Rifle Corps

:d to be known as a "Nation
ı," and it is up to every boy
:ep that title with us.

a National Organization
ıchester Junior Rifle Corps,
ly for the development of
mong boys and girls of
ıch the correct use of a rifle.

ıis organization you will
dle a rifle safely. It will
o compete for the famous
:sman and Sharpshooter
a Winchester Junior Rifle
ers in your town. Your
:aler is probably a repre-
cannot get full particulars
o National Headquarters.
rmation.

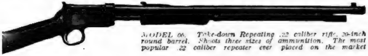
gether a dozen or more of
who want to learn more about rifle shooting and organize a *local branch of the National Winchester Junior Rifle Corps.*

Later on, when enough crack shots have been developed among you, the National Headquarters will arrange matches between picked teams from the different local branches.

If neither you nor your chums own a .22 caliber Winchester you can buy one for a very reasonable sum from your dealer—who has a rifle to suit every boy's pocketbook.

It doesn't make any difference what kind of model you buy, but it must be *.22 caliber* Winchester. It doesn't make any difference in your shooting whether you get a low priced single shot rifle or a fine repeater. The accuracy of a Winchester is in the barrel and the same quality of steel and the same care in boring goes into all.

Get started today. Go to the Winchester Junior Rifle Corps Headquarters in your town and register as a member. If you cannot get all the particulars there, write direct to the **Winchester Junior Rifle Corps, National Headquarters, 275 Winchester Avenue, New Haven, Conn., Division 871.**



MODEL 06. Take-down Repeating .22 caliber rifle, 20-inch round barrel. Shoots three sizes of ammunition. The most popular .22 caliber repeater ever placed on the market

e-down .22 caliber single shot rifle. A lo[w pric]ed, light weight gun made in two sizes

WINCHESTER
World Standard Guns and Ammunition

image
not
available

image
not
available

"That's the tire for me"

"It has the stuff in it that means mileage.

"How do I know? Say!

"Do you see that name, United States? I've had several United States Tires with different treads and they're all good, believe me.

"I've never seen the United States Tire that didn't stand up.

"This chain tread is the one I like best. It's fast and easy and that chain sure does hold the road."

Every boy who rides a bike will find the tire for him among the twelve different United States Tires. A tread and construction to suit every person, every purpose, and all

ed States Cycle Tires are Good Tires

ealer to give you a
Book showing all
States Tires for Bi-
cycles. It has a lot
pictures and read-
ee popular Bicycle
Tread, white walls

with black rubber tread, Heavy Service Traction Tread, all white with motorcycle fabric and herringbone non-skid tread, and Cord Tire, made in the same manner as the famous 'Royal Cord' Automobile Tire. Ask to see them at your dealers.

e Sure It Is United States

otocycle

lotor

n and Upkeep

and Economy

ed. The greatest riding
dle Spring Frame. An ease
riving. Mechanical com-
long, health-giving tours.
model mount for every-
mand. It embraces the
ar. Electrically Equipped

log sent on request

Company
Mass.
World

IS washday th
It need not b
problem by us

We

It does the ha
cylinder of hot s
it does it all at a c

With the Wes
pleasantly done, w
able sewing mac
you manage you

Let electricity h
lem this summe

WESTERN

New York Chicag
Hou

When wri

problem of the week in your home?
u can solve it as well as your servant
ıe

ern Electric
her and Wringer

ɔrk. It washes the clothes in a revolving that there is no wear or tear on them, and about 3 cents for the average family's wash.

lectric Iron to help, the ironing is quickly and he Western Electric vacuum cleaner, port- and other household appliances all help ıe in an up-to-date business fashion.

meet your particular prob- for Booklet No. 21-AT

CTRIC COMPANY
ORATED
Kansas City San Francisco
Principal Cities

WESTE
ELECTR
COMPA
Inc.

Gentlemen :
Please send m
Booklet No. 21-A
describing your electr
Washer and Wringer.

Name__________

Address__________

otocycle

lotor

n and Upkeep

and Economy

eed. The greatest riding
dle Spring Frame. An ease
riving. Mechanical com-
long, health-giving tours.
model mount for every-
emand. It embraces the
ar, Electrically Equipped

log sent on request

Company

. Mass.

e World

IS washday th
It need not b
problem by us

We

It does the ha
cylinder of hot s
it does it all at a c

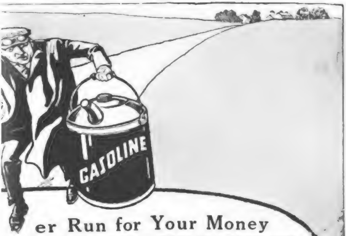
With the Wes
pleasantly done, w
able sewing mac
you manage you

Let electricity h
lem this summe

WESTERN

New York Chicag
Hou

When wri



er Run for Your Money

. have made it. But that "little more" was lacking and you were stuck.

New Stromberg Carburetor

that "little more" gas. It leaves a lot *after* the amount you *now* use is
,est run for your fuel money—most miles per gallon. Saves money on
savings that are too important to be overlooked by *any* motorist.
Literature. Give name—model and year of *your* car.

:OMBERG MOTOR DEVICES CO.,
Dept. 645, 64 E. 25th St., Chicago, Ill.

TROMBERG Does it!
CARBURETOR

arks
ne"juice"
ugs use

our motor would
spark plugs. Each
.ion, less trouble
he same current

IRE

the other
sions soon
any other
sible be-
is used
hst
rect

O.,

n

ORDER BUCKSKIN QUALITY RUBBER TIRES ON APPROVAL
Save 15% to 30% Guaranteed 4000 Miles

YOU take no chance in ordering BUCKSKIN Tires by mail because we send them on a money-back guarantee. And they save you from *$20 to $60 a set*, depending on the size and make you now use. They're guaranteed to give 4,000 miles hard service, though many users get 8,000, 9,000 and 10,000 miles. We also repair all BUCKSKINS *free* at any time, no matter how far they have been run.

Our Attractive Basket Weave Non-Skid Tread

BUCKSKIN TIRES
Plain and Non-Skid Guaranteed

are perfect in construction. Made of finest rubber and most expensive cotton fabric, in a big, new modern plant by skilled workmen. We sell to you direct—this saving cost of middlemen's commissions and credit losses. This is why we can sell high quality tires at prices from 15% to 30% less than you are now paying for other first-class tires.

Express Prepaid Send for price list and users' testimonials. When check accompanies order, we ship anywhere in U. S. or Canada prepaid. If in a hurry for tubes or tires, send size, type and whether plain or non-skid tread is desired and we will ship promptly. C. O. D. shipments, subject to inspection, if desired. Special discount on 4-tire orders.

The L. & M. Rubber Co., John St., Carrollton, Ohio

Manufacturers of Rubber Goods Since 1904
Western Distributing Office
1456 S. Michigan Ave., Chicago, Ill. 18-11

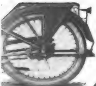
image
not
available

image
not
available

›IVE DETAILS

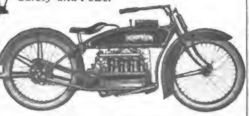
much alike, but it is the exclusive details in design
ne motorcycle far above all others of its type in
ice and satisfaction.

ƆR — HENDERSON



The Only Four Cylinder Automobile Type Motor. Hand or Foot operation Motor Starter. The Lowest Center of Gravity ever attained in a motorcycle.

The Aristocrat of Motorcycles, combining the utmost of Luxury, Comfort, Safety and Power



th Excelsior
lilitary Front
rol, Entirely
›rive Chain,
›pen Bottom
r, and other
XCELSIOR.

:xcelsior Side Car to fit both **Excelsior** and **Henderson** and the **Excelsior**
›mical motorcycle for general utility ever made.

Write for Catalog, or see the Dealer.

MFG. & SUPPLY CO., 3702 Cortland Street, CHICAGO, ILL.

When
pplies

' OFF THE PRESS

:E Book will be
ply Show for over
s Contains many
or 2,000 selections
an easy chair and
ything from bum-
ays refer to it be-
ght now for your
store.

y Ward & Co.
Portland, Ore.

STOP That Leak

Z-Z-Z-Z

with
NEVERLEAK
TIRE FLUID
The Old Reliable 25¢ a tube
BUFFALO SPECIALTY CO. Buffalo, NY

y Way to Make Money

: be content to plod along on a small salary. Be independent.
e tire repairing business and make $60 or more a week. One man made
first day he received his outfit. **Others are making $25 a day and**
:ds of wide-awake men are making $200 to $500 a month.
›erience needed. We teach you how. Very little capital required. But slight risk, as
owner in your town is a possible customer. Jobs are plentiful because tires blow out
ture every day.

HALER *Tire Repair Outfit, $70*

will do as much and as perfect work as the big $250 to $500 vulcanizing outfits. A boy can vulcanize perfectly with this
achine. It's the only vulcanizer that has **Automatic Heat Control.** It must vulcanize
t. It can't undercure or overcure a tire. Requires no watching or regulating. You can
do expert tire vulcanizing in half an hour with the Shaler.

ITE FOR FREE BOOK "HOW TO OPEN A TIRE REPAIR SHOP" and complete Catalog, which gives full information.
WRITE QUICK BEFORE SOME HUSTLER GETS AHEAD OF YOU.

SHALER CO., 2105 Fourth Street, WAUPUN, WIS.

image
not
available

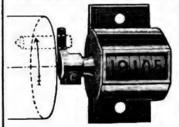
Pushing Machines to Produce at War-speed

You have to know when to *push* a machine if you're going to run it for all it's worth to the nation and to your own business.

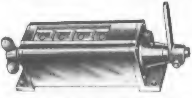
So you'll know just what your machines *should* produce—so you'll hold their output to the *service limit*—is the urgent reason today for using

Veeder COUNTERS

The Revolution Counter below registers one for each revolution of a shaft, recording a machine-operation. The mechanism of this counter will stand continuous high speed, which makes it especially suitable for experimental work in developing, as well as operating machinery. Will subtract if run backward. Price, $1.50.



Where a back-and-forth thrust registers an operation, where you're counting the output of punch-presses or similar machines, use the Set-Back Rotary Ratchet Counter below. Set back to zero by turning knob, and supplied with from 4 to 10 figure-wheels, as required. Price, with 4 wheels, $9.50 (list).



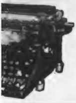
Perhaps you'd like to see counters for other purposes than the above; they're all in our booklet—send your name for a copy.

THE VEEDER MFG. CO.
44 SARGEANT ST., HARTFORD, CONN.

image
not
available

Speak QUICK

R MANU-
'S PRICE!
ing Underwoods
tory, with Back
Lateral Guide,
t, 2-color Ribbon,
er and Special
ing Guide Book
' Free Trial.



nd don't know
Popular Science
: City.

'ERS
Save $25 to $50
y the well-known
l for low cash—
Rental applies on
e for full details
ial.
, Dept. 277, Chicago

A MONTH
Buys a
ible Writing
5, L. C. Smith
nly of standard size with
d universal arrangement—
bulator—two color ribbon—
ction—every operating con-
s' Free Trial. Fully guar-
d special price sent free.
231 N. Wells St., Chicago, Ill.

n Gem
ABLE $
Machine 12

Subtracts

Wonderful
Amberola

for only
a day. Try the New Edison
o buy. Send no money down.
is. Then decide.
look. Send your name and
k and pictures of the New
while this offer lasts.
aph Distributors
Chicago, Illinois

You can now afford to wear

Genuine DIAMONDS at Barnard Import Prices

Secrets of the Diamond Trade
How to judge Diamonds
Diamond Colors
Perfect Cutting
Flaws
Imperfections
How cash methods save 35 per cent
Bankable Guarantee
Free Examination

1/4 Carat

Prices complete for diamond 14K solid gold mounting and Jewel Case.

Blue White	$18.88
Extra Blue White	$26.88
Steel Blue White	$33.25

Our diamond book shows all sizes from 1-16 carat to 3 carat and seven different qualities.

This Free Book

Ignatius Barnard
President

tells you all you want to know about diamonds— how to buy them, **safely** and **intelligently**—why diamonds are the world's best investment—how I save you 35% by direct importing and eliminating all middlemen—how because my business comes from all over the world, I can succeed in spite of small profits—how I can afford to sell mountings at factory **cost**—how I offer diamonds in seven qualities and all carat sizes, so that you can now afford to wear genuine diamonds at my less than wholesale price.

Send No Money!

You take no risk under my free examination plan. Just select your diamond and favorite setting from my book and I will ship it so that you can examine it without the slightest obligation to buy. My costly De Luxe Book of Diamonds shows the world's most sensational diamond bargains and I back them with the only

Bankable Money-Back GUARANTEE

Issued **only** by Barnard—**Diamond Headquarters** permits you to cash in your diamond investment within one year and to exchange at full value at any time. A written legal certificate of carat weight, color and value.

Prices going up every day, save money by writing immediately!

Barnard & Co.
Diamond Headquarters

N. W. Cor. State & Monroe Sts., Dept. 3988S, CHICAGO, U. S. A.

Use this Coupon for Free Book

BARNARD & CO., Dept. 3988S
N. W. Cor. State & Monroe Sts., CHICAGO
Without expense or obligation, please send me, Free postage paid, 1918 De Luxe Diamond Book.

NAME...

ADDRESS...

image
not
available

t!"

him. Let
him hard!
especially

DE
MOTOR

1918 Evin-
ss running.
Built-In Fly-

or it.
CO.
aukee, Wis.

tland, Ore.

Oil Engine

Canoes"

y It is
in a staunch,
master canoe!
air and invigor-
octor can write
cription?
eful, buoyant and
flash they respond
own carry you far
le or a short run to
nenic lunch. Write
lso illustrates the
canoe in the world.
NOE CO.
Old Town, Maine

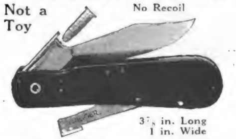
COMBINATION
KNIFE and PISTOL

Knife for everyday use
Pistol for every emergency

Shoots .22 Long Cartridge

Not a Toy

No Recoil



3⅞ in. Long
1 in. Wide

Protect your home or when out nights

Practical, useful novelty—small, light, compact and effective. Regular Pistol cleverly concealed in high grade knife, with large, keen blade of best cutlery steel.

Mechanical Marvel Needed by every soldier and sailor in uniform—every sportsman and fisherman—protection for every home. Discharges any *.22* **long** or short as effectively as any pistol made—automatic safety makes it without danger to use. Think of it—this mechanical marvel, perfect in workmanship and operation, at a cost much less than for any ordinary pistol. Nickel finished, packed in neat, plain box, all complete, postage prepaid—only . . . **$3**

Don't delay—send TODAY.

Knife Closed

U. S. SMALL ARMS CO., INC.
1265 First National Bank Bldg., Chicago, Ill.

WRITE NOW for truly superb 1918 Catalog. Beautiful, Instructive. Packed with money-saving offers. Everything in Cameras, Lenses, Kodaks, Photo Supplies on **10 Days Free Trial — Money Back Guarantee.**

DAVID STERN COMPANY
622 Daysco Building
In Business Since 188
1027 Madison St., Chicago, Ill

Save Camera Money

SERVICE RINGS

SOLID GOLD $7.50
Any Branch of the Service

STERLING SILVER $2.00
Your own Regiment and Company Included.

Special Prices on orders of six or more.

CATALOG FREE

C. K. GROUSE CO., Manufacturers,
123 Bruce Ave. :: North Attleboro, Mass.

image
not
available

BOYS

Big Money in Electricity

The electrical industries offer wonderful opportunities to boys with a liking for Electricity. The salaries paid to trained men are large, promotion comes rapidly and, best of all, the work is fascinating.

The discovery and development of new lines (such as wireless telegraphy and telephony), from time to time, promise attractive and paying fields to those who wish to specialize. The *will to do* and *Special Training* will bring success to *you*.

The International Correspondence Schools can help you to become an expert in electrical work, no matter what branch you like best. Thousands of young men have already won success through I.C.S. help. You can do as well as anybody, *if you try*. Everything is made so clear that you can learn in your spare time, regardless of where you live or what your work. No books to buy.

There's big money in Electricity. Get after it by marking and mailing the Coupon today. *Finding out costs you nothing.*

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 5883 SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- ☐ ELECTRICAL ENGINEER
- ☐ Electrician
- ☐ Electric Wiring
- ☐ Electric Lighting
- ☐ Electric Car Running
- ☐ Heavy Electric Traction
- ☐ Electrical Draftsman
- ☐ Electric Machine Designer
- ☐ Telegraph Expert
- ☐ Practical Telephony
- ☐ MECHANICAL ENGINEER
- ☐ Mechanical Draftsman
- ☐ Machine Shop Practice
- ☐ Gas Engineer
- ☐ CIVIL ENGINEER
- ☐ Surveying and Mapping
- ☐ MINE FOREMAN OR ENGINEER
- ☐ Metallurgist or Prospector
- ☐ STATIONARY ENGINEER
- ☐ ARCHITECT
- ☐ Architectural Draftsman
- ☐ PLUMBING AND HEATING
- ☐ Sheet Metal Worker
- ☐ CHEMICAL ENGINEER
- ☐ SALESMANSHIP
- ☐ ADVERTISING MAN
- ☐ Window Trimmer
- ☐ Show Card Writer
- ☐ Outdoor Sign Painter
- ☐ RAILROADER
- ☐ ILLUSTRATOR
- ☐ DESIGNER
- ☐ BOOKKEEPER
- ☐ Stenographer and Typist
- ☐ Cert. Public Accountant
- ☐ Railway Accountant
- ☐ Commercial Law
- ☐ GOOD ENGLISH
- ☐ Common School Subjects
- ☐ CIVIL SERVICE
- ☐ Railway Mail Clerk
- ☐ Textile Overseer or Supt.
- ☐ AGRICULTURE
- ☐ Navigator
- ☐ Poultry Raising
- ☐ Automobiles
- ☐ Spanish
- ☐ German
- ☐ French
- ☐ Italian

Name ______________________________

Present Occupation ______________________________

Street and No. ______________________________

City ____________________ State ____________

If name of Course you want is not in this list, write it below.

image
not
available

ENTS TRADE-MARKS AND COPYRIGHTS

GEST PATENT FIRM IN THE WORLD

VICTOR J. EVANS

SPECIAL OFFER

'ree Opinion as to Patentability

ore sending your invention to any attorney or man-cturer or disclosing your invention, write for our blank form PROOF OF CONCEPTION in order to protect your invention and secure yo..r rights. This should be signed and witnessed and returned to us, together with a model or sketch and description of your invention, and we will give a FREE OPINION as to the patentability of the invention. If we report the invention patentable we will furnish a Certificate of Patentability.

This Certificate of Patentability, together with our blank form Proof of Conception will protect the inventor and serve as proof of the invention until the case can be filed in the U. S. Patent Office

Obtaining Assistance for Inventors—Our certificate is of great assistance to inventors who require financial aid to obtain patents.

OUR FIVE BOOKS MAILED FREE

(See Coupon Below)

to any address. Send for these books—the finest publications ever issued for free distribution

How to Obtain a Patent

Our illustrated eighty-page Guide Book is a book of reference for inventors and contains 100 mechanical movements, illustrated and described. Tells how to invent for profit.

What to Invent

Contains a valuable **list of inventions wanted** and suggestions concerning profitable fields of inventions; also information regarding **prizes offered for inventions amounting to**

One Million Dollars

Millions in Trade-Marks

Shows the value of Trade-Marks and information regarding unfair competition.

List of Patent Buyers

Contains requests from manufacturers, mail order houses and promoters for patents secured by us and suggestions as to **New Ideas** they wish to purchase. We place our clients in touch with capital free of charge. We have recently received over 300 requests from manufacturers.

Foreign Patents

We have direct agencies in all the principal foreign countries and secure **foreign patents** in the shortest possible **time** and at the **lowest cost**. Write for our illustrated Guide Book on Foreign Patents, sent free to any address.

We Advertise Our Clients' Inventions Free in a list of Sunday newspapers, in manufacturers' journals and in World's Progress. Sample Copy Free. We save you time and money in securing patents. After the patent is granted we assist you **to sell your patent.**

WANTED NEW IDEAS

Prepare Now to meet the Demands of Industry in All Fields for New Ideas and New Inventions. We are constantly receiving requests from manufacturers who consult us when purchasing patents for inventions in all lines. We invite manufacturers and promoters to address our Sales Department regarding the purchase or leasing of a number of meritorious patents secured by us.

VICTOR BUILDING

'REE COUPON!

J. EVANS & CO.

PATENT ATTORNEYS

:sburg Office: 514 Empire Bldg.

Philadelphia Offices: 1423 Chestnut St.

Ninth St., WASHINGTON, D. C.

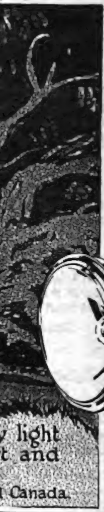
................*Address*.........................

Digitized by Google

image
not
available

image not available


URAD
URKISH CIGARETTE
MURAD
THE
RKISH
RETTE
18 CENTS



This is No. 4702
One of 77 different styles of Dayl